Pit and Quarry

With which is consolidated CEMENT-MILL & QUARRY

Member Audit Bureau of Circulations

Read in Largest Number of Plants

Vol. XXIII November 18, 1931 No. 4

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Vol. XXIII CHICAGO, NOVEMBER 18, 1931 No. 4

New England Stone Men Meet at Boston

MARKETING TOPICS DISCUSSED

The New England Crushed Stone Assn. held its regular monthly meeting and luncheon on Friday, Nov. 6, at the Parker House in Boston, Mass. A representative group of members attended. Local problems of the industry were the main topics of discussion.

President Bernard A. McKinney presided over the meeting. A. L. Bratt, testing engineer, Massachusetts Department of Public Works, was introduced and discussed methods to be used to promote the use of certain sizes of aggregates not now finding a ready market. A. T. Goldbeck then reviewed the research work done by the National Crushed Stone Assn. during the year. Subjects of particular interest were tests of the comparative stability of crushed stone and sand and gravel for railway ballast and the manufacture of stone sand. Mr. Goldbeck also spoke of the plans being made for the national convention to be held in Pittsburgh in January.

A. L. Worthen also discussed the national convention and emphasized the fact that ample time will be set aside on the program for the inspection of the machinery exhibits. W. E. Hilliard spoke of the progress of the Committee on Uniform Cost Accounting of which he is chairman.

Subjects of local interest were then discussed, and the date of the next meeting set for Friday, Dec. 11, at the Parker House. At that time all committees will present their reports and final preparation for the national convention will then be made. The invitation of J. R. Boyd, executive secretary of the national association, for the local unit to hold its annual dinner at 6:00 p. m. on Wednesday, Jan. 20, 1932, was accepted and most of those present signified their intention of attending.

A list of those attending the luncheon and meeting follows:

E. R. Atwood, Old Colony Crushed Stone Co., Quincy, Mass.

A. L. Bratt, Massachusetts Department of Public Works, Boston, Mass.

H. R. Brownson, Rowe Contracting Co., Malden, Mass.

Mr. Burkhart, Massachusetts Broken Stone Co., Stony Brook, Mass.

T. C. Cooke, Lynn Sand & Stone Co., Swampscott, Mass.

L. A. Eames, Holliston Trap Rock Co., Boston, Mass.

A. T. Goldbeck, National Crushed Stone Assn., Washington, D. C.

Otho M. Graves, General Crushed Stone Co., Easton, Pa.

Wm. E. Hilliard, New Haven Trap Rock Co., New Haven, Conn.

G. Keefe, Metropolitan Crushed Stone Co.

H. W. Kummel, Lynn Sand & Stone Co., Swampscott, Mass.

C. H. Latham, Lynn Sand & Stone Co., Swampscott, Mass.

W. B. Lenhart, *Rock Products*, Chicago.

Frank Long, West Roxbury Trap Rock Co., West Roxbury, Mass.

M. McDonough, Malden Crushed Stone Co., Malden, Mass.

B. A. McKinney, West Roxbury Trap Rock Co., West Roxbury, Mass.

T. Pallatto, Dracut, Mass.

E. T. Perry, New Haven Trap Rock Co., New Haven, Conn.

H. Robinson, Massachusetts Broken Stone Co., Stony Brook, Mass.

L. Robinson, Massachusetts Broken Stone Co., Stony Brook, Mass.

W. E. Trauffer, PIT AND QUARRY, Chicago.

C. Wellington, Massachusetts Broken Stone Co., Stony Brook, Mass.

A. L. Worthen, Connecticut Quarries Co., New Haven, Conn.

Signs of Recovery

France Stone Co. works night and day at Bloomville, O. . . . . W. J. Breen Gravel Co., Grand Rapids, Mich., lets contract for $100,000 plant . . . . Two sites under consideration for new $6,000,000 cement plant in California . . . . Ideal Sand & Gravel Co., Mason City, Ia., operates at capacity . . . . Anaconda resumes production at Idaho phosphate-rock mines . . . . Construction of $125,000 marble-finishing mill starts at Andrews, N. C. . . . . Portland Cement Co. of Utah begins full-time operation.

W. D. Callender, Head of "Rock Products" Is Dead

W. D. Callender, 61 years old, president of the Tradepress Publishing Corp. of Chicago, publisher of *Rock Products*, died Nov. 9 in a hospital at Highland Park, Ill., of cerebral hemorrhage. Among the papers published by his concern, besides *Rock Products*, are *Barrel and Box*, and *Concrete Products*. He was also interested in another magazine, *Trunks and Leather Goods*. Mr. Callender came to Chicago about 1910. In recent years he had lived on a farm near Naperville, Ill., a Chicago suburb. Funeral services and burial took place at New Brighton, N. Y.

Alpha Plant Unveils Cement Safety Award

CEREMONY AT CEMENTON, N. Y.

Representing the reward for several years' determined effort on the part of the plant personnel, the cast-stone safety trophy awarded by the Portland Cement Assn. for a perfect accident record for the year 1930 was unveiled with fitting ceremonies at the Alpha Portland Cement Co. plant at Cementon, N. Y., on Thursday afternoon, Oct. 15. The entire town turned out to join in the celebration, including all the school children whose work had been suspended for the occasion. About 700 persons were present, surrounding the trophy which had been placed in the center of an attractive green parkway on the plant grounds.

E. C. Sandt, plant chemist, presided at the dedication and introduced L. E. Andrews, assistant engineer of the Portland Cement Assn. in New York, who in a congratulatory address presented the trophy to the plant. The monument was unveiled by the Misses Pearl and Juanita Ziegler, daughters of Daniel Ziegler, plant engineer and chairman of the plant's safety committee.

The trophy was accepted by Edward M. Flanagan, foreman of the machine shop.

G. S. Brown, president of the Alpha company, was then introduced by Mr. Sandt as one of the outstanding safety advocates of the cement industry.

After Mr. Brown's message to his employees, Mr. Sandt then introduced the following other honorary guests: Mr. McKelvy, vice-president of the company; N. D. Colburn, general superintendent of the company and former superintendent of the Catskill plant; Mr. Hamilton, the company's safety director; Arch Brown, superintendent of the Catskill plant; Daniel Ziegler, chairman of its safety committee; and Dr. Mahlon H. Atkinson, company physician.

After the formal ceremonies were over the company furnished the assemblage with refreshments, during the serving of which a program of entertainment was presented by workers in the plant.

The trophy represents the reward for several years' determined effort on the part of the plant personnel. The plant almost won in 1929, having but one accident.

Holds "Featherweight" Unfit as Trade Mark

TILE CO. SEEKS REHEARING

Because the commissioner of patents considers the word "featherweight" to be descriptive of an article which is light in weight but not to be taken literally, he has rejected the application of the Federal Cement Tile Co. of Chicago, asking registration of the term as a trade-mark for concrete roof slabs. This finding has resulted in a petition by the company for a review before the five judges who constitute the United States Court of Customs and Patent Appeals. The argument will be advanced that not only is the term not a descriptive one and therefore not registrable, but also that the patent office has on many past occasions seen fit to allow exclusive use of the word as a mark for articles of various kinds, including aluminum and alloys, pumps and engines, eye shades, dress shields, horseshoes, suspenders, ladies' hair combs, heel cushions, men's garters, baby pacifiers, and carbon paper.

In rejection of the proposed mark, the commissioner referred to the application of Harry Berger, who sought to use the same mark on apparel and who was refused this privilege for the reason that the term is descriptive only. Continuing, he says:

"Applicant's goods are roof slabs of concrete. Lightness is as desirable a quality in a roof as in a man's summer attire. A featherweight roof slab is a light slab, presumably the lightest slab. No one supposes that either a shirt or a roof slab can actually be made comparable to a feather in weight. The mark is equally hyperbole in both cases and equally good English according to Webster. It simply conveys the informations that the goods (whatever goods) to which it is applied are extremely light."

In endeavoring to distinguish the two cases, counsel for the Federal company says, in part:

"The examiner surely can not seriously contend that clothing when spoken of as being of the weight of a feather is an exaggerated use of that word. However, when he suggests that concrete slabs may be of featherweight, it is unquestionably an exaggeration which no one would consider using unless the word 'featherweight' as applied to concrete had been given an artificial meaning because of its use in this connection, as for example in the instant case where it has been used as a trade-name for a material which, because of its very nature, is always thought of as quite heavy."

Lets Contract for New $100,000 Gravel Plant

The W. J. Breen Gravel Co. of Grand Rapids, Mich., has awarded the general contract to Owen-Ames-Kimball Co., Grand Rapids, for its new sand-and-gravel washing, storage and distributing plant. The equipment will include storage bins, loading docks, mechanical-washing equipment, conveying machinery, etc., to cost about $100,000.

Will Construct $125,000 Marble-Finishing Mill

Construction of a $125,000 marble-finishing plant near Andrews, S. C., is scheduled for this winter by the Columbia Marble Co. of Knoxville, Tenn. The plant is to be of all-steel construction and the contract for the material has been let to the Converse Bridge & Steel Co. of Chattanooga, Tenn. The company now operates two quarries near the plant and is planning to open another early next spring.

Utah Cement Plant Back on Production Schedule

The Portland Cement Company of Utah of which Ashby Snow is president, has ordered 100 of its employees back to work on a full-time basis and at their former wages. The company's plant at Salt Lake City had been idle since July.

France Stone Co. Plant Working Night and Day

Because of a rush of orders for crushed stone, the quarry and plant of the France Stone Co. near Bloomville, O., are working both night and day. Prospects indicate that operations will continue at capacity for several weeks.

Widow of Chapin A. Day Is Victim of Pneumonia

Mrs. Chapin A. Day, widow of Chapin A. Day, head of the Utah-Idaho Portland Cement Co. of Ogden, Utah, who died early in October passed away in a Los Angeles hospital on October 31. Her death was due to pneumonia said to have been brought on by a cold caught while attending her husband's funeral.

Mrs. Day was born in Chicago in 1850. She was the mother of the wife of Ralph E. Bristol, manager of the cement company of which Mr. Day was president.

New Ohio Plant Replaces One Destroyed in Blaze

Production has been started at the new Ada, O., plant of the Taylor Stone Co., with a capacity of 250 tons of crushed stone per day. The new plant is located one and one-half miles north of Ada. The former plant at this location was destroyed by fire last July.

The plant is now in operation for ten hours each day, but will soon be shifted to include two daily work periods, each eight hours in length.

The crusher and elevator used were brought from the company's plant at Marseilles, O.

Offer New Trophy as Quarry Safety Award

BRONZE PLAQUE IS PROVIDED

A new trophy to be competed for by members of the National Crushed Stone Assn. is being provided by the *Explosives Engineer* magazine, published by the Hercules Powder Co., it is announced by Theodore Marvin, editor. The trophy goes to the quarry which leads the members of the association in the annual National Safety Competition which is conducted by the U. S. Bureau of Mines for The Sentinel of Safety trophies.

Because of the outstanding record of winning the quarry trophy for three successive years, Cape Girardeau plant of the Marquette Cement Manufacturing Co. has gained permanent possession of the former trophy offered by the *Explosives Engineer*.

The trophy is a bronze plaque symbolic of quarrying. It is a facsimile of a scene on the Sentinels of Safety trophy which is offered by the *Explosives Engineer* to the winners of the National Safety Competition, a nation-wide contest in which coal mines, metal mines, and quarries compete in Safety.

Certificates of honor from the Secretary of Commerce were given to fifteen quarry companies who went through the year without a lost-time accident.

In winning the 1930 contest, the Marquette plant had a perfect safety record with a total exposure of 224,514 man-hours. The new trophy, according to Mr. Marvin, will be ready for the 1931 winner of the National Crushed Stone Assn. contest.

Resumes Work at Idaho Phosphate-Rock Plant

The Anaconda Copper Mining Co. has resumed operations at its phosphate-rock deposits located near Soda Springs, Ida. The mine and processing plant had been closed for about three months. Rock is shipped to Anaconda, Mont., where it is treated with sulphuric acid to produce superphosphate for fertilizer.

Iowa Operator Improves Plant, River Equipment

The Molo Sand & Gravel Co., Dubuque, Ia., operator of a Mississippi River steam dredge serving six barges, and with a river plant at Dubuque, has abandoned the measuring of its material by volume and has adopted weight measurement, with plant improvements made to include a 25-ton scale unit, plant office and other changes in handling materials taken from the river and from three pits owned by the company and accessible to its floating river equipment.

With the end of river navigation during the month of November, two of the barges go into dry dock and other units of the fleet will tie up in the harbor for overhauling and repairs.

Capacity Output Follows Idleness Due to Drought

The Ideal Sand & Gravel Co., Mason City, Ia., is working full time at present to replenish its stock-piles which are at a low ebb due to an enforced plant shutdown this summer for 60 days because of drought conditions. Approximately 150,000 tons of sand and gravel were handled at the plant during the present season.

In the preparation of material for marketing the plant is compelled to rely upon an 18,000,000-gal. water storage reservoir and uses 3,200 gal. per min. The state also uses this reservoir as a hatchery for bass. Because of this fact a certain water level must be maintained. It is only in such a year as the unusually dry season of 1931 that the company is inconvenienced in this manner.

Consider Two California Sites for Cement Plant

Two California sites, one at San Pedro and the other at Los Nietos, are being considered for the erection of a $6,000,000 cement plant for the exclusive production of quick-hardening Portland cement, according to press reports. Aman Moore, Los Angeles cement engineer and financier, is reported to be behind the proposed project.

Huge Asphalt Plant in New Mexico in Operation

Development has been started of what is said to be the largest known rock-asphalt deposit in the United States. It is near Santa Rosa, N. M., and has been explored for a length of twelve miles and a width of two miles. It is estimated to contain more than three million tons of material. A crushing-and-screening plant has been constructed and the material is being shipped to various points in the Southwest.

Stone Firm to Preserve Scenic Beauty of Mount

The Hudson River Stone Co., which recently purchased Mt. Taurus on the Hudson River, near Beacon, N. Y., has announced that operations for quarrying stone will be carried on in such a manner that the scenic face of the mountain along the river will not be disturbed. The stone, a typical Hudson River trap rock, will be marketed in the New York metropolitan area.

Bronzos Valley Gravel Co. Sold to Gifford-Hill

Gifford-Hill Co., Inc., Dallas, Tex., operating numerous sand-and-gravel properties in that area, has purchased the plant and property of the Bronzos Valley Gravel Co., near Calvert, Tex., and will operate it as one of its units. Plans are under way for the opening up of a new pit, with digging, elevating, conveying, loading and other equipment.

Union Sand & Gravel Co. Acquires Ironton Plant

Announcement has been made of the purchase of the Ironton Gravel Co. by the Union Sand & Gravel Co. of Ironton, O. The storage yard of the newly-acquired plant has been restocked with a wide variety of sizes of commercial aggregate.

Vancouver Granite Co. Makes Plant Addition

The Vancouver Granite Co., Vancouver, Wash., has completed the construction of an addition to its plant. Machinery is to be installed later, according to W. M. Maky, one of the officials of the concern.

To Supply Material for Bridge-Protection Piers

The Logsdon Sand & Gravel Co. of Rushville, Ill., has been awarded a $15,000 contract to supply material for the construction of protection piers at the Mississippi River bridge at Beardstown, Ill. Curtis Logsdon is president of the concern.

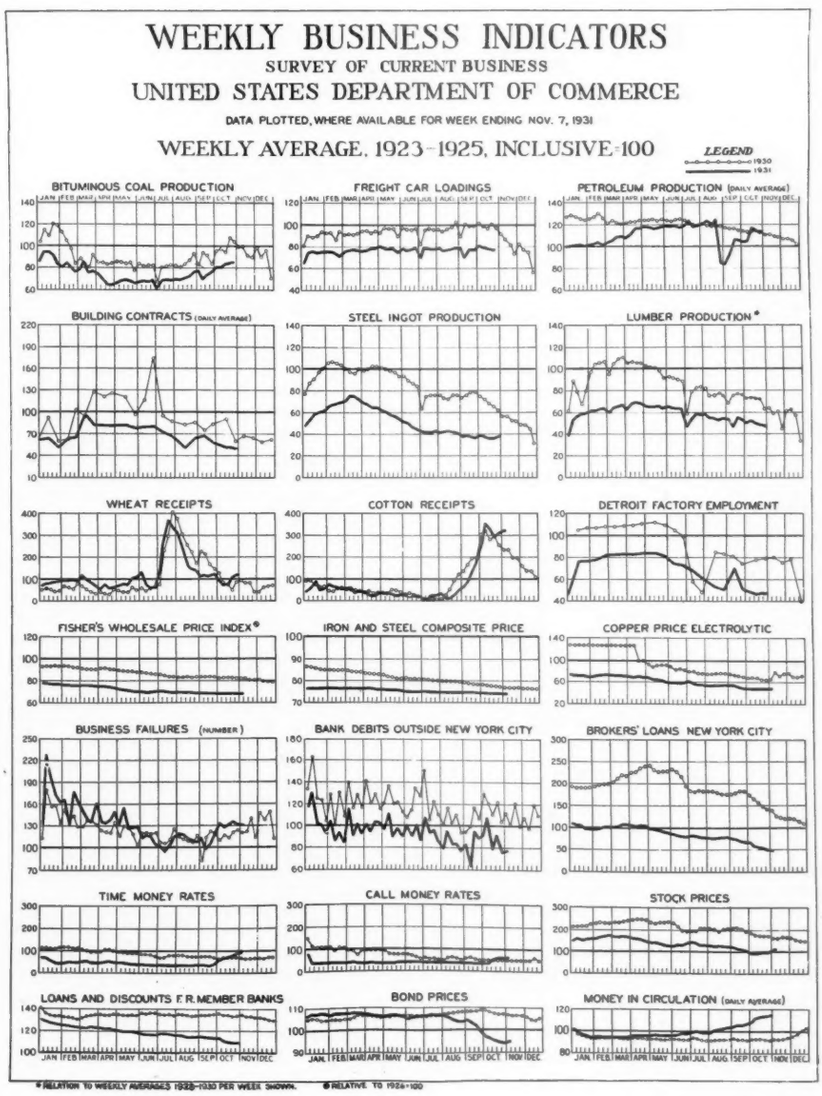
LeGrand Stone Producer Opens Des Moines Office

The LeGrand Limestone Co., LeGrand, Ia., producer of crushed stone and ground limestone for agricultural purposes, has opened an office in the Insurance Bldg., Des Moines, Ia.

Starts Producing Gravel at Plant Near Saratoga

The Northern New York Sand & Gravel Corp. has started production of washed gravel at its plant located near Saratoga Springs, N. Y. The material is to be used in state-highway construction in that vicinity.

Robert J. Piersol, who has been a practicing consulting engineer, is now physicist with the State Geological Survey of the state of Illinois, and is located at Urbana.



Editorials

The Fire Hazard

THERE are still many plants in our industries which exhibit a strange inconsistency on the part of their owners. The condition to which we refer is the still common use of combustible materials in plant construction. It is, of course, natural that the desire to keep capital investment at the minimum should favor the use of wood construction wherever possible, although it would seem to be equally natural that one who builds for permanence should utilize those materials and those forms of construction which guard against the greatest enemy of permanence, fire.

Impermanent plants will probably always be built of perishable materials, since the objective in each case—the exploitation and exhaustion of a relatively small deposit—will usually be reached before the passage of much time presents the fire hazard in menacing form. But there has undoubtedly been too great a tendency in the past to construct large and permanent plants of impermanent materials. Huge sums have been invested in costly and efficient machinery, yet the inclosing structures have too often been of flimsy construction and of inflammable materials. Attention has been centered chiefly on the immediate means of production—the processing machinery and its accessory equipment—yet the necessity for protecting the large investment involved from the fire hazard has in many cases been either overlooked or deliberately disregarded. The fact that fires, however slight their effect on the processing equipment, often cause their chief damage through interruptions to production is not given its proper weight when the potential fire danger is considered. As a result one often sees machinery of thoroughly modern type housed in buildings which present a constant menace to the realization of that continuity and economy of production for which the machinery was acquired.

To a casual observer it must appear inconsistent that industries producing fire-proof materials, much of whose usefulness to social and business life depends on their fire-resisting qualities, should display such a disregard of the advantages of incombustibility when choosing the materials of which their plants are constructed. The fact that this disregard is common must be attributed more to the influence of false economy practiced when existing plants were built than to a lack of appreciation of the importance of fire-proof construction. The use of combustible materials has been due principally to the fact that the cheapness of inflammable construction has seemed to outweigh the probable cost of loss through fire.

While the erection of a fire-proof plant costs somewhat more than that of the combustible type, the difference is a small portion of the total cost of building and operating that plant during its normal life. What is more, the adoption of fire-proof construction is certain to prolong the life of the plant and, so, reduce the amount of overhead due to capital investment which is chargeable against each unit of product. Even though an extension of the normal life expectancy of a plant exposes it to a greater number of fire hazards, the adoption of fire-proof construction reduces the danger of those hazards and may practically eliminate them.

During recent months many disastrous fires among nonmetallic-mineral plants have been reported, and nearly all have occurred in plants built of combustible materials. Although the resulting destruction has in most cases necessitated the rebuilding of the plants along modern lines—including the adoption of fire-proof construction—it has inflicted an unnecessary hardship on the owners by interrupting production and, in some cases, withdrawing the plant as a producing unit from a whole year's business. The costs of such interruptions far outweigh the greater cost of fire-proof construction and have been sufficiently great to show the wisdom of adopting permanent materials for the destroyed plant's successor. Costly experience is teaching what any engineer or equipment manufacturer would normally recommend as good practice, yet in these days of widespread knowledge of fire hazards it should not be necessary to pay the costs of a serious fire in order to discover the great advantages of fire-proof construction.

Ethics and Profits

WHEN Benjamin Franklin uttered his famous pronouncement to the effect that "honesty is the best policy" he spoke not as a moralist but as a practical man. He did not urge the adoption of honesty because of its inherent rightness, nor would he have suggested the avoidance of dishonesty because of its inherent wrongness. On the contrary, he advocated honesty because it is profitable, because it is expensive to have a reputation for dishonesty, because it is costly to pursue sharp practices and get caught. Surely this is a sound attitude for a practical man. The test of how far a man practices what is now dignified by the term "business ethics" is a knowledge of how far he is successful in furthering his own interests at all costs without being detected either by his competitor or by his customer. Public opinion, in so far as it seems to take notice of ethical problems and to pass judgment, appears to approve any form of action that one can "get away with."

Despite the assurances of the moralists it is true that typical men are little disturbed or even concerned about ethics; least of all the business man, to whom ethical practice has often appeared to be the very antithesis of good business. Certainly such improvements as have been made in the conduct of business, along lines that are generally accounted "fair," have not come about because of

their fairness, nor even because they did not have the disastrous effects which the business man expected, but rather because they operated to his financial advantage. Whenever "ethical practices" become useful practices in a business sense, they are certain to be adopted.

It was not so long ago that appeals for the improvement of working conditions, for the shortening of the hours of labor, and for other betterments suggested by humanitarian considerations were based on morals, and the teachings of great moralists were quoted in an effort to demonstrate the iniquity of those who would not place the interests of their employees above their own. The lack of progress made by this procedure was evident from the opposition it encountered—an opposition which, because it revolved about the profit motive, was considered evidence of deep moral turpitude. But now such appeals—except where they are backed by force—are based on a demonstration of the business man's self-interest, which, under the process of demonstration, becomes the "enlightened self-interest" of the modern economists. And, as the result, business men now favor shorter hours, safer working conditions, and the other improvements that have come because they operate to his advantage and not because of their conformity to moral doctrine. So that, as Franklin might have said with equal truth, "fairness," "consideration," "open dealing" also represent "the best policy."

In our industries, as in many others, great improvements in social directions are being introduced and promise to become accepted practice largely, if not solely, because they pay handsome dividends. As long as the appeal for the reduction or elimination of dust hazards, for example, was based on humanitarian reasons the movement made little or no headway. But just as soon as it was possible to demonstrate the financial advantages of dust collection, either through the reduction in claims for injury and death, or through the disposal of salable recovered products, or both, interest quickened and money was found for an investment that promised such large returns.

And so it will be with other trade practices, whether these touch the relations between competitors or those between seller and buyer. The rules promulgated by trade-practice conferences give expression to high ethical ideals, but their adoption will depend less on the strength of their appeal to conscience than on that of their appeal to cost. "If you would reach a man's heart, touch his purse," said a wise man. The moralists scornfully called him "cynic," yet every new "ethical" advance proves the truth of his utterance.

Price-cutting, rebating, defamation of a competitor, misrepresentation of quality, and all the other all-too-common trade practices which business men are urged to avoid will meet their doom when men understand fully the price they must pay—if not now, at some future time—for violation of the law of compensation. Every action has its reaction, and when men become enlightened as to the extent of the reaction, they may be expected to take a different view of the action that causes it. The reaction may take the form of legal penalty, loss of trade, or failure in business, but in any case it will cause financial damage and, so, demonstrate its costliness.

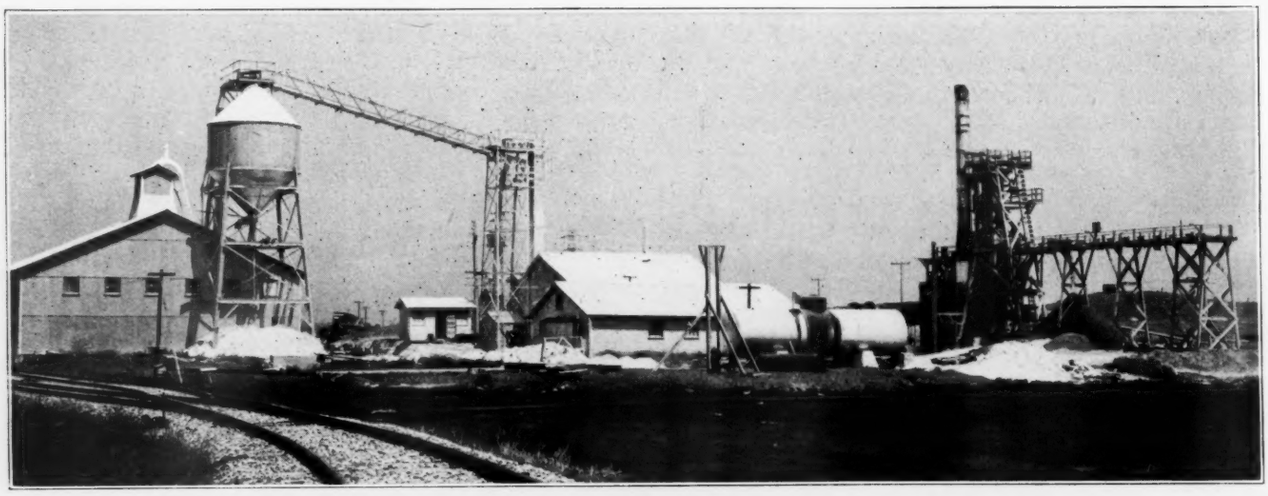
An ethical practice will become a common practice when it can be shown to be a profitable practice. That expresses the relationship that exists between business ethics and business profits. The future of business will depend very largely on the extent to which business generally accepts this truth and governs its activities by it. Many of the most successful businesses are those which have rediscovered this truth and are applying it.

And in those larger problems of employment, production control, price stabilization, and the like, relief will come along "ethical" lines just as soon as men can be shown that it is to their advantage to take an interest in them and to strive for their solution. "What is everybody's business" continues to be "nobody's business" largely because the cost to everybody of ignoring the problems that constitute "everybody's business" have not been sufficiently demonstrated. What passes for altruism will be more common when the gains of self-interest are made more obvious. The "cut-throat competition and promiscuous wage-slashing" to which Secretary of Labor Doak recently referred will be corrected when business men realize that they are expensive in the end and that the terms "just price" and "fair wage" are not merely the grandiloquent mouthings of a medieval clergy but the expression of practical as well as ethical goals.

A. S. T. M. 1931 Edition of Tentative Standards Published

The Book of A. S. T. M. Tentative Standards is an annual publication. The 1931 book (1,008 pages) contains 180 tentative specifications, methods of test, definitions of terms and recommended practices in effect at the time of publication. The term "tentative" applies to a proposed standard published for one or more years, with a view of eliciting criticism, before it is formally adopted as standard by the society. In the 1931 book, 44 of the tentative standards relate to metals and 136 to nonmetallic minerals and products. Although these tentative standards are in the trial stage of A. S. T. M. procedure, they represent the latest thoughts of the committees on these specific subjects.

The 42 new tentative standards which have been developed this year are published in the 1931 book. In the nonmetallic-minerals field there are specifications for sand for use in lime plaster; gypsum wall-board, gypsum lath and sheathing board. There are many new important standards in the concrete field, including concrete aggregates and several methods of curing Portland-cement concrete slabs. Tentative methods of test are given for the apparent specific gravity of coarse aggregates in a saturated condition; and for the structural strength of fine aggregate using constant water-cement-ratio mortar.



The lime plant. Hydrator building at left; kiln building, center; and washing plant at right.

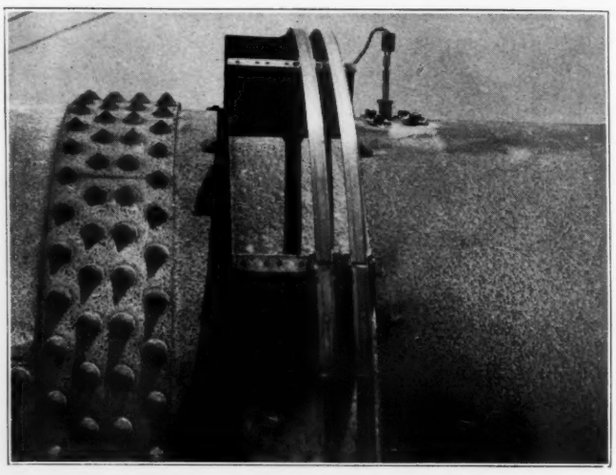
California Rotary-Kiln Lime Plant Uses Oyster Shells as Raw Material

Output Used Principally to Convert Brine-Works Bittern into Ethylene Dibromide and Hydrate of Magnesia

THE number of lime plants operating on the Pacific Coast was augmented during the past year by the new plant of the California Chemical Corp. at Newark, Cal. This is a rotary-kiln plant producing both quicklime and hydrated lime and uses oyster shells as raw material. The company is primarily a manufacturer of chemicals of various kinds, but this plant produces commercial lime as well as chemical lime for use in its processes. A brief summary of the history of this company explains the reasons for its becoming a lime producer and a factor in the California lime industry.

Several years ago the California Chemical Corp. began experimental work at its Porterville, Cal., magnesite plant with the purpose of making magnesium hydrate from bittern, which is the brine left over from a salt works after all the available salt is taken out. This brine includes among its ingredients bromine and magnesium chloride. In order to do this successfully a uniform source of dependable composition lime had to be found. A small portable lime plant, which used oyster shells shipped from San Francisco Bay as raw material, was built at Porterville. As this lime proved to be very satisfactory, the new lime plant was built at the company's Newark chemical plant and went into operation in the autumn of 1930. One of the chemical operations at Newark is the conversion of the bromine from bittern into ethylene dibromide, one of the major constituents of ethyl gasoline.

A view of the hydrator.

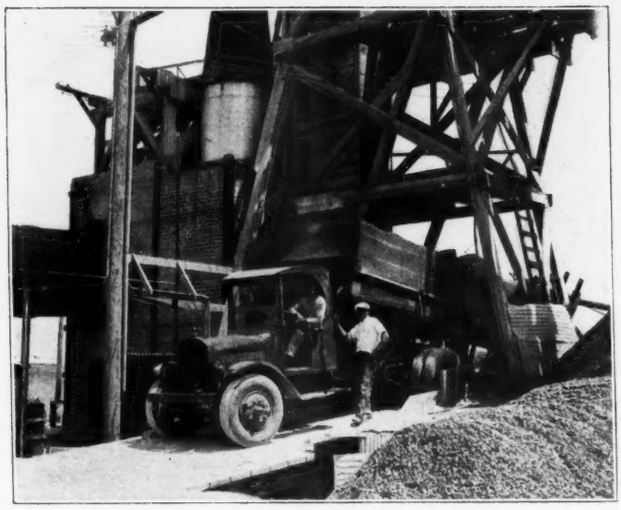


Contact rings and thermo-couple for indicating kiln temperatures.

The location of these plants is 1½ mi. west of Newark, Cal., which is about 25 mi. southeast of

San Francisco and only a few miles from San Francisco Bay. The location is ideal in every way, as the oyster shells used in making the lime come from the bay and an ample supply of bittern is available from the many near salt plants which get their salt from the bay water. The plant is on a spur track of the Southern Pacific Ry. and is close enough to the bay so that barge shipments are also practical.

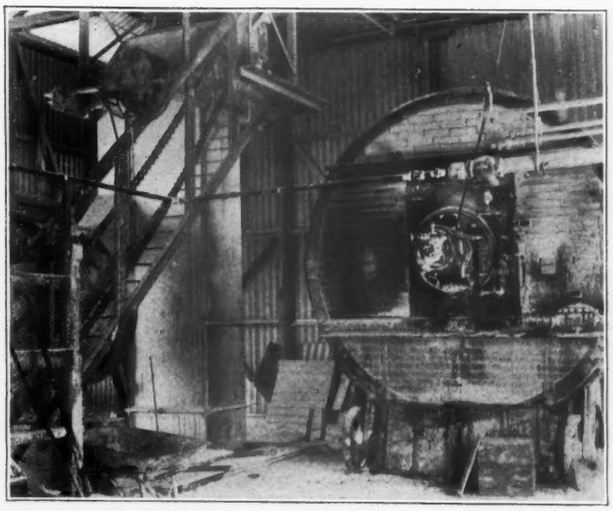
The oyster shells used as raw material are dredged by an independent dredging company from extensive deposits found on the southern end of San Francisco Bay. The shells are washed on the dredge



Truck discharging a load of shells to the washing plant.

until they have a silica content of from 1/10 to 4/10 of one per cent. The washed shells are then loaded on a barge, which is towed up a 3-mi. slough from the bay to a point some distance from the plant. This barge has its own timber boom and bucket and unloads the shell to timber hoppers on the shore. Trucks are loaded under these hoppers and haul the shells to the lime plant. An 8,000-ft. canal will later be dug from the bay to the plant so that the shells can be delivered to the plant without rehandling.

The shells are dumped from the trucks at the plant into a hopper feeding to a bucket-elevator, which discharges to a horizontal stock-piling conveyor with a tripper. This system has a storage

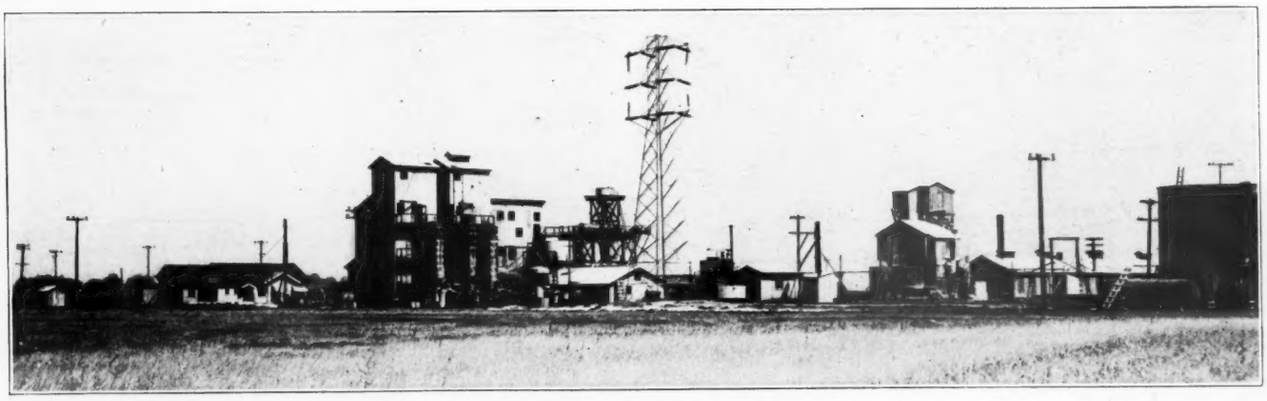


Firing end of the kiln with elevator at the left.

capacity of 5,000 cu.yd. and allows the shells to lose a considerable part of their moisture content. The shells are reclaimed by a belt-conveyor in a timber tunnel under the stock-pile. This conveyor feeds to the same elevator handling the washed shells. A split-chute arrangement discharges the washed and drained shells to the 100-ton timber kiln-feed bin. A water-jacketed screw-conveyor feeds the shells to the kiln.

A small experimental washing plant alongside the kiln-feed bin was used to collect data from which to build a new dredge now almost completed. This dredge has a 10-in. centrifugal pump and will feed to a special barge which is also under construction. The shells, which are very fine and light, will be unloaded from the barge by an air-conveyor system operated by a pump on the shore near the unloading dock. All washing of the shells will be done on the dredge, where they will also be dewatered before loading to the barge.

The 80-ft. rotary kiln is bottle-shaped and has a diameter of 6 ft. at the feed end and 7 ft. at the discharge end. It is lined with crystalline-magnesium-oxide (periclase) fire-brick of the company's own manufacture which will withstand any fuel-fire temperature and is inert to lime. This brick has proved very satisfactory even under the unusually high kiln temperatures of 3,050 to 3,100



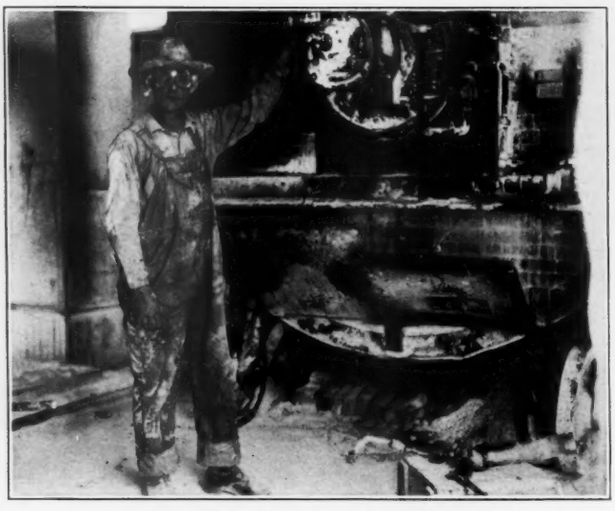
A general view of the bittern plant.

A view showing the pulverizer, the packers and hydrator.

deg. F. used in this kiln to develop certain physical properties of the lime for chemical purposes.

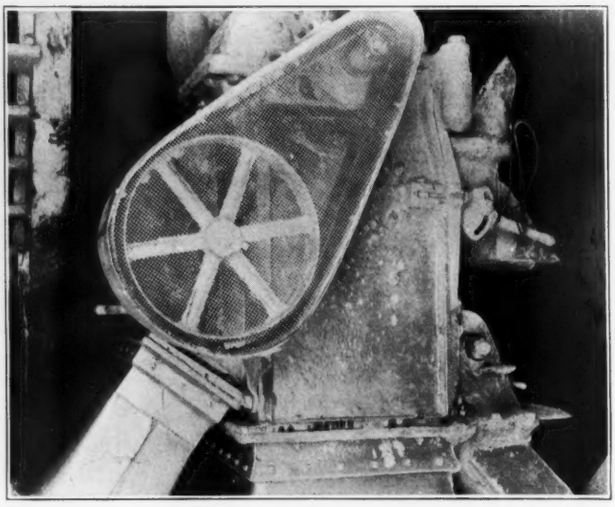
The kiln is fired by a W. S. Ray Mfg. Co. oil-burning system. Natural gas was at first used for burning but was found unsatisfactory for the high temperature required. Equipment for burning gas is kept on hand so that it can be used again in an emergency or if changing conditions make its use advisable. A thermo-couple, with contact rings at the center of the kiln, allows temperature readings to be made at this point and a pyrometer at the feed and gives stack-temperature readings.

The kiln is at present driven at a speed of one revolution in 1.2 min. and has a capacity of about 30 tons in 24 hr., although a 50 per cent. greater capacity can be obtained when necessary. The kiln discharges to a Bodinson manganese-steel double-chain bucket-elevator which feeds to the 5-ft. by 20-ft. rotary cooler. This elevator has operated satisfactorily in spite of the intense heat of the lime and the air in which it operates. A stack at the top of the elevator sets up a cooling current of air through the cooler and elevator, eliminating the necessity of an artificial draft.



An operator at the rotary kiln.

The cooler discharges to another steel-inclosed chain-bucket elevator and to a 10-in. by 40-ft. screw-conveyor which feeds to a 150-ton steel storage tank supported on structural framework above the hydrator building. Foundations are in place for a second tank for additional storage capacity. The lime can be discharged through any of three spouts



The drive of the pulverizer.

in the bottom of this bin. One spout leading to the ground can be used as a waste spout if necessary. The other two lead inside the hydrator building. One of these feeds a short inclined belt-conveyor for loading quicklime direct into cars.

The third spout feeds by a reciprocating feeder of the company's own design into the McGann Schult-

Operator at the packer wearing goggles and dust-mask.

hess continuous hydrator, which has a capacity of 2½ tons per hr. The hydrated lime is chuted directly into a Raymond mill and cyclone, which has a capacity of 1½ tons per hr. of regular hydrate with 98 per cent. through 200-mesh. When producing chemical hydrate with 99.5 per cent. through 325-mesh about half that capacity is obtained. The production of such a finely-ground lime is made

(*Continued on page 43*)

Pennsylvania's Nonmetallic Minerals Are Worth $110,000,000 Each Year*

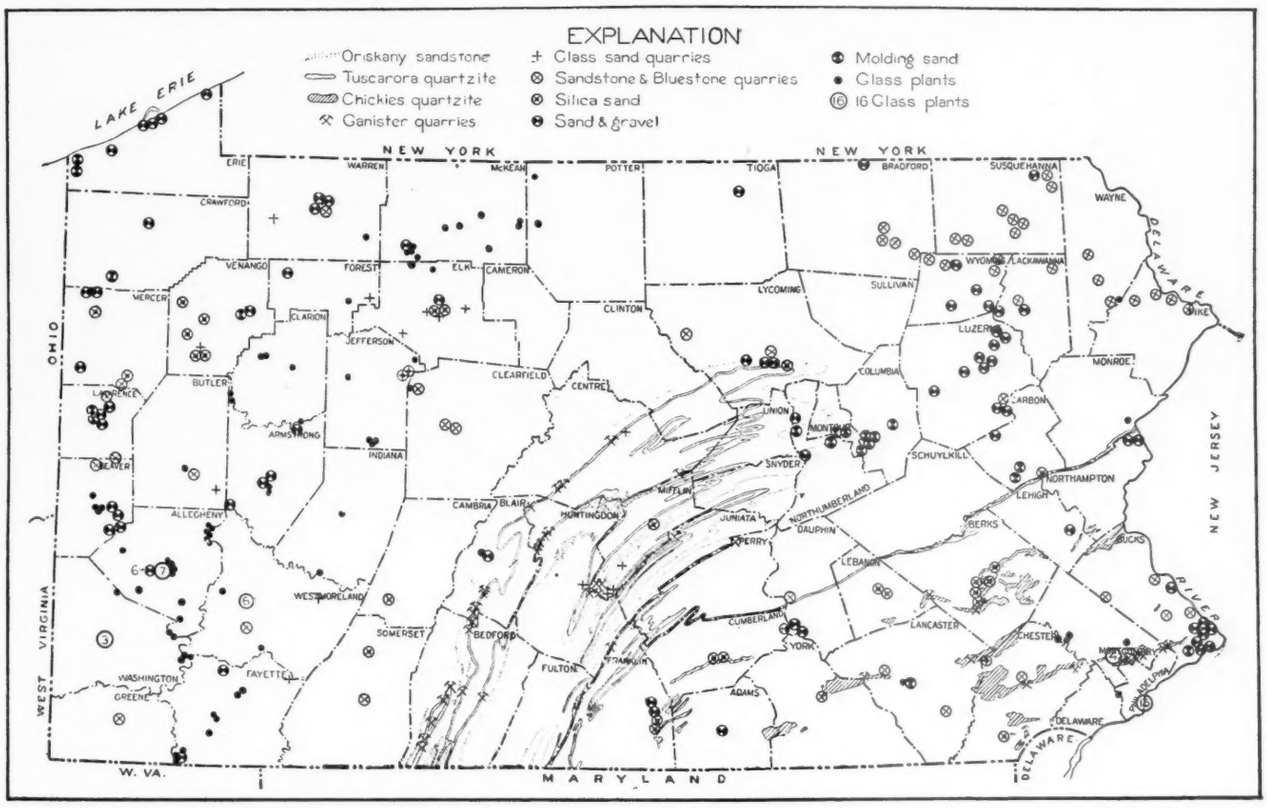


Fig. 1. Sandstone and quartzite formations and locations of sand, gravel and ganister operations.

Leads All States in Cement Production; Ranks Fourth in Crushed-Stone Output

By RALPH W. STONE
Asst. State Geologist

TO those familiar with the mineral industry of the United States it is well known that Pennsylvania is by far the largest producer, with an annual output valued in some years at well over $1,000,000,000. The value of this output is more than that of any country in the world, except the United States, and in some years exceeds that of Great Britain by a very fair margin. It is accounted for largely by the quantity of hard and soft coal, petroleum, and natural gas. When we omit these fuels, and Pennsylvania's metals (iron, copper, gold, and silver), there remains a very sizable nonmetallic-mineral industry, amounting to $110,000,000.

Only nine states have a total annual mineral output of greater value than this small part of Pennsylvania's industry. This $110,000,000 is produced almost wholly by four major products, cement, stone, sand and gravel, and clay. The cement output alone has sold in the last five years for $55,000,000 to $70,000,000 a year, stone for $19,000,000 to $20,000,000, sand and gravel for $13,000,000, and the value of raw clay sold or used is estimated at more than $10,000,000 yearly.

With such huge quantities of material being produced it may be questioned if the supply will not soon be exhausted. So far as can be foreseen by

Quarry operated by Booth & Flinn at Longbridge, Westmoreland County.

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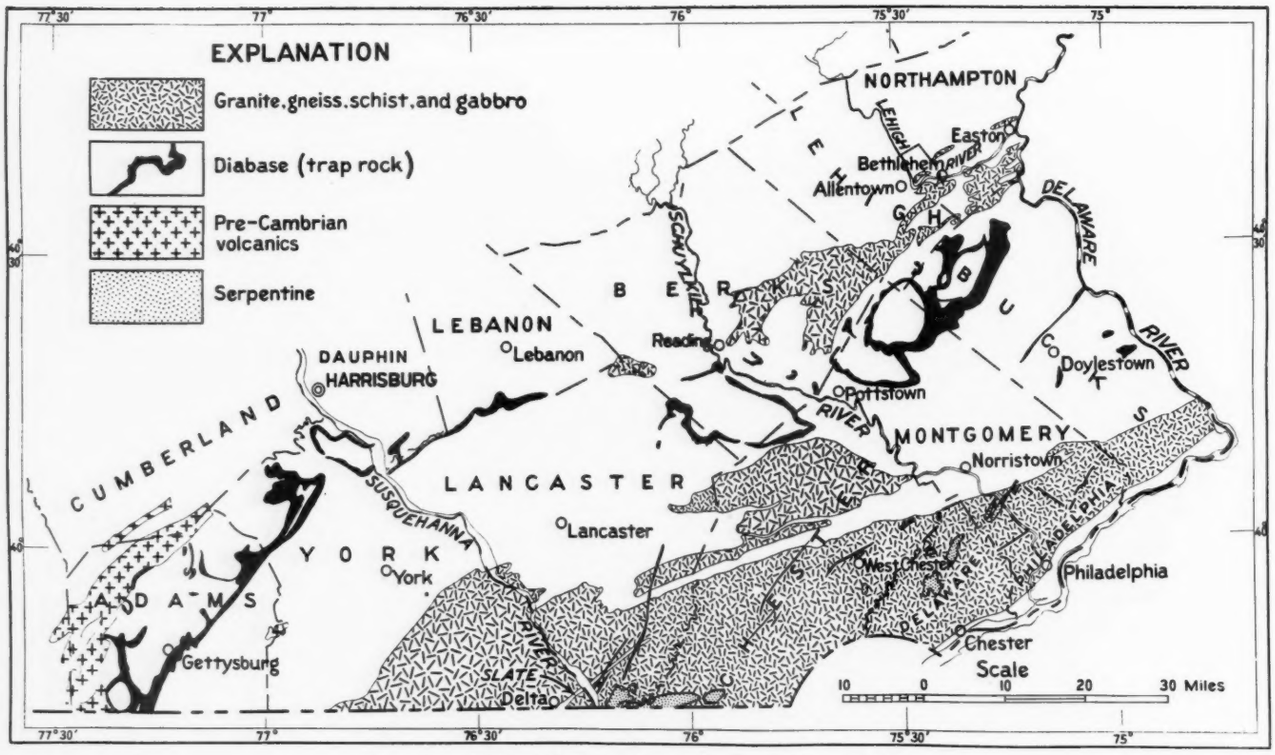


Fig. 2. Geological map of southeastern Pennsylvania.

the Geological Survey the cement and stone industries have unlimited natural resources, deposits adequate for a continued large-scale production for a century to come, and possibly for several centuries.

It is conceivable that the present sources of building sand and gravel in the Philadelphia and Pittsburgh districts may become impoverished in a few decades, if not sooner, but the glacial deposits in the northern part of the state constitute an inexhaustible reserve.

Of some minerals, like talc, the known supply is small. Rock salt is believed to be present in great quantity in some areas but at considerable depth and at present probably could not be produced eco-

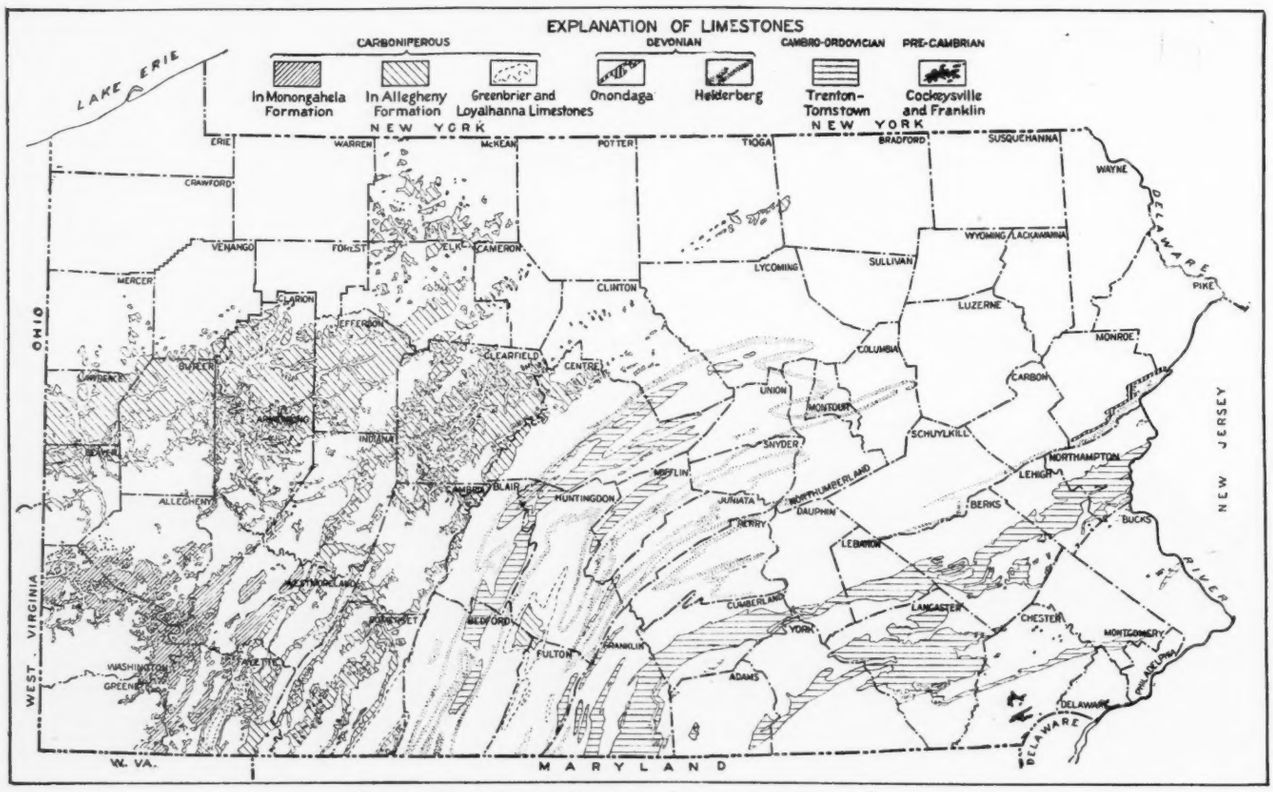


Fig. 3. Map showing limestone formations in Pennsylvania.

nomically in view of the shallower deposits in New York and Michigan. Graphite occurs in good quantity but further attention must be given to the means of separation.

With the foregoing introduction to the general subject, the various phases of the nonmetallic-mineral industry in Pennsylvania may be summarized. The discussion necessarily is brief but the Geological Survey courts inquiry and will gladly furnish additional information on any of these subjects. So far as falls legitimately in its province the survey will gladly assist by consultation or otherwise in the plans or problems of anyone interested in the further development of the mineral industry in this state.

Crushed Stone.—In 1929 Pennsylvania ranked fourth among the states in the quantity of crushed stone produced, being surpassed only by New York, Ohio, and California. This includes only the material used for concrete, road metal, and railroad ballast, and amounted to 7,884,550 tons, valued at $9,350,627. Granite, gneiss, trap, limestone, dolomite sandstone, and quartzite are the kinds of stone entering into this grand total.

Among the larger quarries in this business are those of the General Crushed Stone Co. at White Haven, Rock Hill, and Glen Mills, producing 1,000 to 3,000 tons daily, and those of the John T. Dyer Co. near Birdsboro which have a combined capacity of more than 5,000 tons daily. Probably the longest quarry face operated for crushed stone is that of Booth & Flynn at McCance, Westmoreland County, which exposes 60 ft. of siliceous limestone for a half mile in a straight line.

No state has better highways than Pennsylvania and hundreds of thousands of tons of crushed stone are used annually in their construction and maintenance. The State Highway Department has little difficulty in getting crushed stone within reasonable trucking distance of most of its operations.

Cement.—One of the first plants in the United States which produced Portland cement on a commercial scale was built on the Lehigh River in Pennsylvania in 1879. The state has always led in the production and its output is around 40,000,000 bbl. yearly. Her nearest competitors are California and Michigan with annual productions of 13,000,000 to 15,000,000 bbl. each.

Most of the twenty-eight Portland-cement plants in Pennsylvania are in the Lehigh district at the eastern end of the state where cement rock abounds.

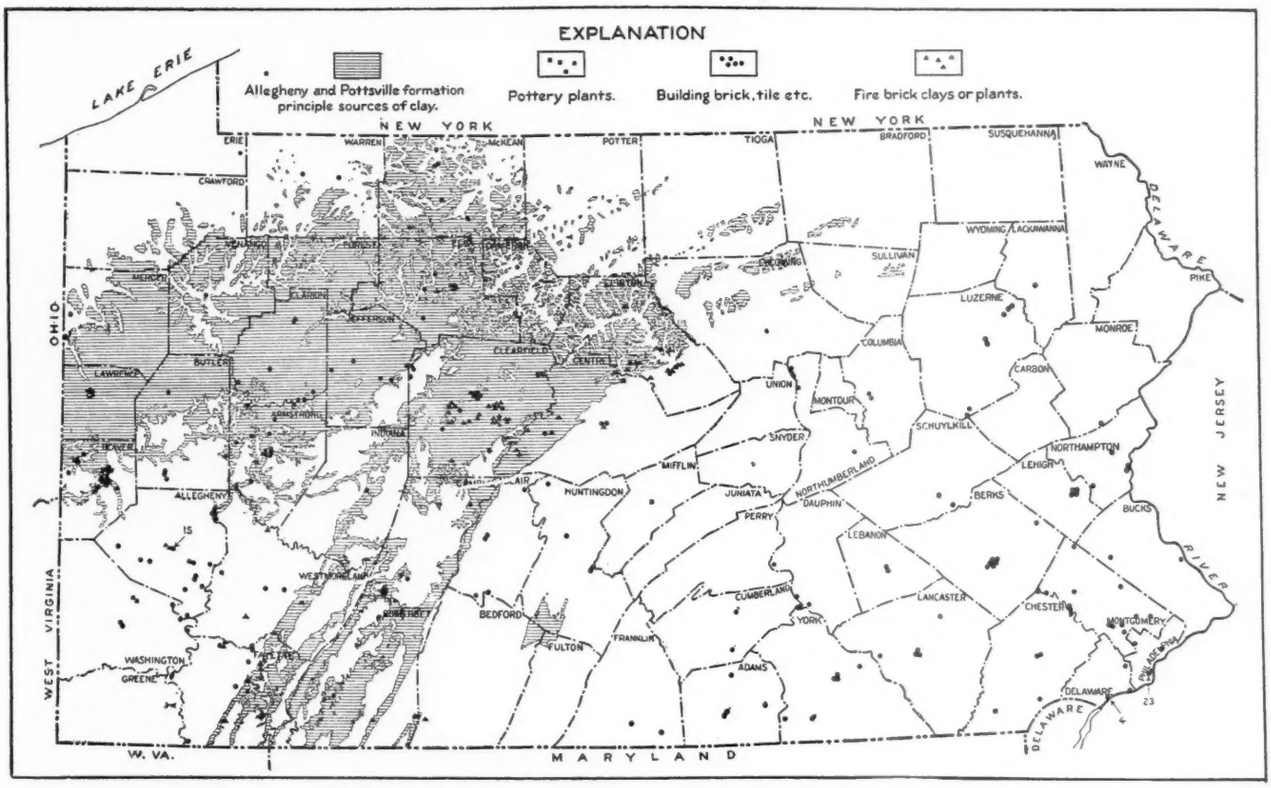


Fig. 4. Map showing clay resources and plants utilizing the materials.

Several plants are operating in the western end of the state, at Bessemer, Wampum, Universal, and West Winfield, using the Vanport limestone. One is at York and one at Conshohocken, near Philadel-

Atlas Portland Cement Co. quarry at Northampton.

Quarry of Alpha Portland Cement Co. at Martins Creek. Plant in background.

phia. Two of the plants near Pittsburgh get limestone from underground mines; the others are supplied by large quarries.

Building Sand.—The total production of all sand and gravel in the state is about 13,000,000 tons annually, valued at $11,000,000 to $13,000,000. Sand for use in plaster, mortar, and concrete and for paving, and gravel for use in concrete, paving, and railroad ballast account for 11,000,000 tons of the output. Two main sources of this material are at opposite ends of the state. On the broad flat bank of Delaware River north of Philadelphia sand and gravel are dug by great dredges floating in artificial ponds. Dippers and bucket lines work to a depth of 30 or 40 ft. below the surface. The material is thoroughly washed and screened, and shipped both by boat and rail. Smaller operations using power-shovels work in these same deposits above water level. North of Easton there are sand-and-gravel pits in glacial deposits along the Delaware and at a number of places in the northeastern counties.

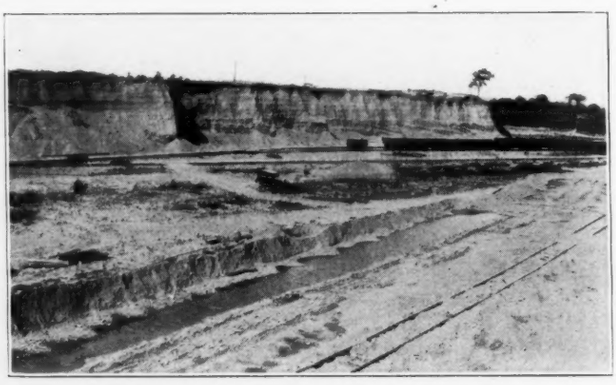
In the west end of the state great quantities of sand and gravel are dredged from the bottom of Ohio, Allegheny and Monongahela Rivers in the vicinity of Pittsburgh, and at more remote places, as Point Marion in Fayette County. Some of the largest and most modern all-electric, floating dredges in the country are operating in the Pittsburgh area.

Other sources of sand and gravel for building are in the glaciated counties in the northwestern part of the state, as on the shore of Lake Erie, and on French Creek near Jamesville. The central part of the state is lacking in such deposits, and Harrisburg has used much sand and gravel from Delaware River and Chesapeake Bay 100 mi. away. This summer, however, extensive deposits on a terrace along Susquehanna River at Highspire, a few miles below Harrisburg, were opened and are furnishing washed sand and gravel of high grade to the capital city.

The supply of sand and gravel along the rivers in the Philadelphia and Pittsburgh districts will last for many years. Many counties in the northeastern and northwestern parts of the state are covered with a mantle of glacial deposits which constitute an inexhaustible supply for the more remote future. In the meantime light-weight aggregate for concrete may be demanded and this will be supplied by shale burned to a porous clinker, as is being done now in the Pittsburgh district.

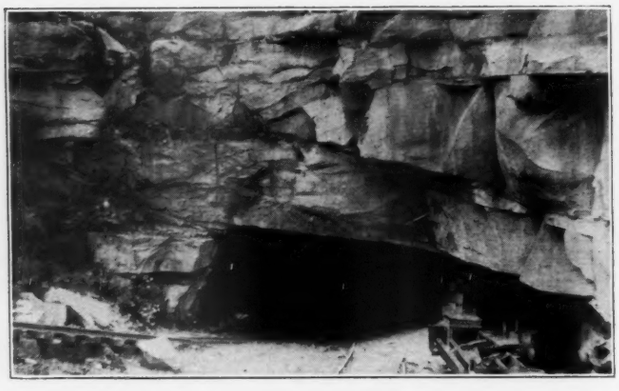
Another view of the Alpha quarry at Martins Creek.

Glass Sand.—High-grade silica sand for glass making is produced in greater quantity by only two states, Illinois and West Virginia. The output in Pennsylvania is about 450,000 tons a year, valued at $900,000. The principal source is the Oriskany sandstone in Huntingdon County (Fig. 1). At Mapleton the beds stand nearly on edge and quarrying has developed a face about 200 ft. high and a quarter mile long. The rock is shot down, loaded by power-shovels, and hauled in mine cars to one of the largest glass-sand plants in the country, where it is crushed and washed to a snowy whiteness.



Gravel pit located near Fairview.

The Oriskany sandstone outcrops for hundreds of miles in the central, mountainous part of the



Entrance to Clarion sandstone mine of the Winfield Sand Co.

Silica-sand quarry near Honeybrook.

state and is commonly a high-grade silica sand, but not everywhere so pure as at Mapleton.

Silica Sand.—In even greater quantity than for glass, high-grade silica sand is used for grinding and polishing, for molding steel, refractory purposes, filter and traction sand. In the Pittsburgh district more than 2,000 people are engaged in making plate glass. Silica sand forms the bulk of its

View in a gravel pit in Erie County.

composition, and grinding sand reduces the rolled plate to a smooth surface ready for polishing. The polishing sand is produced largely in Elk, Jefferson, Venango, Westmoreland and other counties in the western end of the state (Fig. 1) by quarrying and grinding the siliceous sandstones at the base of the Coal Measure formations.

Sand from these same localities is used in molding steel castings in the Pittsburgh district. Steel plants in the eastern end of the state use sand from

Glass-sand workings in Oriskany sandstone at Mapleton Depot.

local rock-grinding plants or from the unconsolidated deposits in New Jersey.

The annual production of grinding and fire sand in Pennsylvania approximates 600,000 tons valued close to $800,000.

Molding Sand.—Natural bonded molding sand for casting metals is dug in considerable quantity on Delaware River above Philadelphia, on Susquehanna River near Danville and Cattawissa, along the shore of Lake Erie, and in several other places

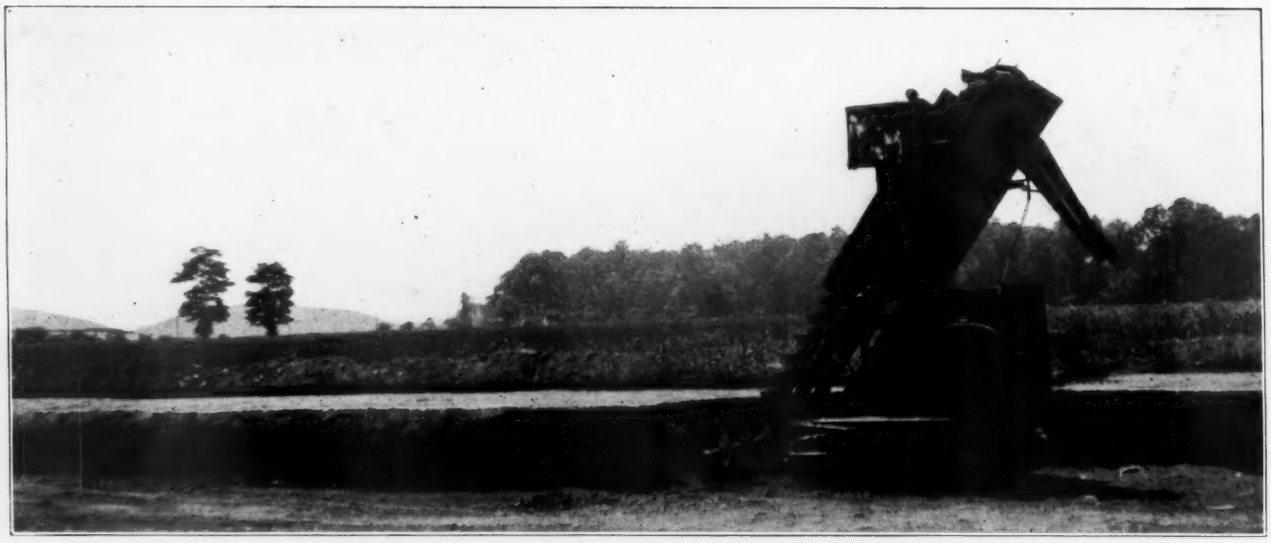
Mifflin Sand Co. pit near Lewistown.

(Fig. 1). The unconsolidated deposits lying just below the sod are dug mostly by pick and shovel and loaded in wagons for hauling to the railroad cars. Near Tullytown on Delaware River they are also dug by a special machine operated by a gasoline engine. The annual output is more than 300,000 tons.

Granite, Gneiss and Schist.—In southeastern Pennsylvania, particularly in the Philadelphia district but extending to Allentown and Reading (Fig. 2), a considerable variety of igneous and metamorphosed sedimentary rocks is quarried for building stone and for crushed stone. These rocks

Excavating glass sand near Lewistown. Mifflin Sand Co.

include granite, granite gneiss, mica gneiss, hornblende gneiss, mica schist, gabbro, and kindred varieties, and quarries in them are numerous. Most of them are producing rough building stone and the number of stone houses in some neighborhoods is notable. Mica schist and the various gneisses in the immediate vicinity of Philadelphia make excellent building stone and their durability is attested by small churches that were erected as early as 1715 and are still in use.



Digging molding sand near Tulleytown. Note the clean removal of overburden.

Swarthmore and Bryn Mawr Colleges and many other institutions near Philadelphia are built of the local mica gneiss, and of granite gneiss, which differs from granite only in that the minerals have a banded arrangement. Washington Memorial Chapel at Valley Forge is granite gneiss from Holmesburg, in Philadelphia, where a large quarry has been developed to a depth of 100 ft.

Many of the building-stone quarries are comparatively small and of intermittent operation, but some, like the Leiper quarry near Swarthmore, have been operated more than 100 years and have attained sizable dimensions. Crushed-stone quarries in these rocks range all the way from small ones operated by portable machinery for a single job to those

An extensive limestone quarry at Billmeyer.

capable of a large daily output. A quarry in gabbro at Glen Mills, Delaware County, during the present period is shipping 1,300 tons daily from a completely-electrified modern crushing plant.

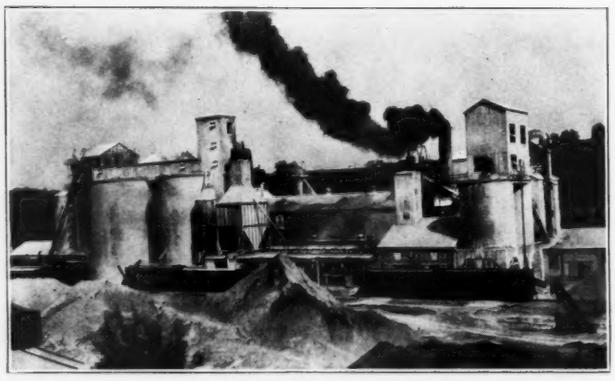
Granite for use largely in churches and schools is quarried in South Mountain between Reading and Allentown. Some of it has a reddish color, takes a high polish, and might be used for monuments except that the color is irregular in distribution. This feature is inconspicious in rubble and rock-face ashlar.

"Black granite" or diabase is quarried at Coopersburg and Saint Peters and polished for monument stock. The highly-polished black surfaces of this fine-grained granitoid stone show carving well and are highly resistant to weathering. This polished stone sawed in slabs would be suitable

Pulverizing mill and packer in a whiting plant at Norristown.

for exterior and interior paneling in office buildings, banks, etc. The Shakespeare Memorial in front of the Free Public Library on Logan Circle, Philadelphia, is made of this "black granite."

The output of granite and related rocks in Penn-



Part of the plant of the American Lime Co. at Bellefonte.

sylvania in 1929 for building, paving, curbing, rubble and crushed stone was 285,540 tons, valued at $598,912.

Trap Rock.—Considerable areas of diabase, trap, or "black granite" intruded in the Triassic sediments are exposed in southeastern Pennsylvania between Bethlehem and Gettysburg (Fig. 2). This hard black rock meets all the requirements of the Pennsylvania Department of Highways and is used extensively for road metal; also for aggregate in

Headframe of limestone mine near Bellefonte. American Lime & Stone Co.

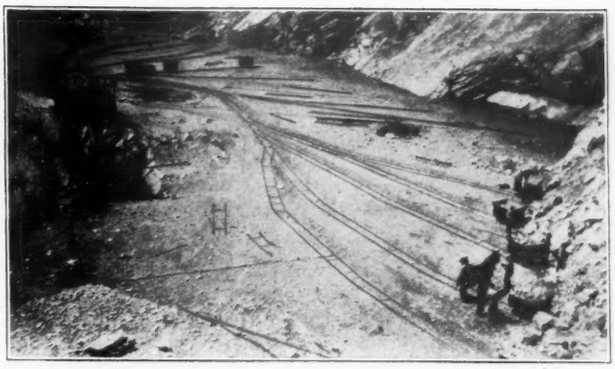
concrete for general building purposes. One quarry near Birdsboro has a production capacity of 4,000 tons daily, and one near Quakertown about 3,000 tons. This stone also makes excellent paving blocks. Although it is durable and can be dressed to ashlar, it is little used for building stone because the color is so dark that it makes a somber building. The effect can be lightened by extra wide and white mortar joints.

A 6-cu.yd. shovel loading limestone in a quarry near Cornwall.

Two quarries in this stone are being worked for "black granite" monument stock.

The production in 1929 was 1,443,610 tons, valued at $2,143,164. Only 19,000 tons of this output was for rough building and riprap.

Serpentine.—The only serpentine quarry now operating is in the southern part of Lancaster County (Fig. 2) and is producing two shades of fine chips for terrazzo floors. The operation is a simple one of shooting down a face now over 70 ft. high and crushing to the desired size. The chips are shipped in sacks.



Yoch & Roberts dolomite quarry near Norristown.

Serpentine quarried in Chester County from 1870 for 30 yr. was used for building stone in the Philadelphia region. It did not prove very durable, especially in cities, and quarrying has long been abandoned.

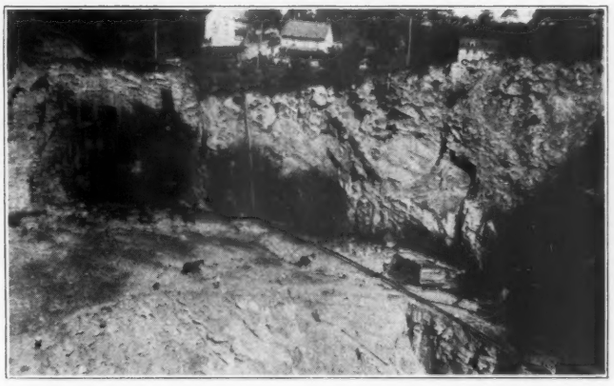
Verde antique occurring at Easton has been sawed and polished for interior use, but not in late years.

Talc.—At a quarry on Delaware River above

Stacy & Wilton limestone quarry located in Adams County.

Easton talc has been produced for many years. It is ground to a fine powder and used for filler in paint, etc.

Limestone.—Pennsylvania is the largest producer of limestone in the United States, although her lead over Ohio and Michigan is narrow. The value of Indiana's output of rough architectural and finished building stone exceeds that of all Pennsylvania's



Quarry of the Spring Creek Limestone Co. at Swatara.

Crusher house and incline from quarry, near Norristown.

limestone but the output in tons is little more than a third of that of Pennsylvania's total. Table I shows the quantity produced, by uses:

In addition to this, Pennsylvania produced millions of tons used in making Portland cement, and 782,000 tons of lime, the stone for which is not included in Table I.

Limestone is widely distributed over the state except in the northern tier of counties (Fig. 3). In several places it is produced by underground mining, as at Bellefonte, Wampum, Ellwood City, and West Winfield. The limestone includes high-calcium stone for chemical use, dolomite that is high in magnesia, and siliceous limestone that is about 50 per cent. silica.

Bluestone quarry operated by Geo. Pratt near Nicholson.

Marble.—At Marble Hall near Norristown, at King of Prussia near Valley Forge, and in Chester Valley near Downingtown are idle quarries in white and blue-white marble that were worked extensively many years ago and furnished much building stone to Philadelphia. Some quarries followed the nearly vertical beds to a depth of 100 to 200 ft. A marble quarry near Norristown is worked by drifts and tunnels 100 ft. below the surface and the stone is pulverized and sold for whiting.

Sandstone and Bluestone.—Under this head is included only the stone used for building purposes in blocks or slabs, not crushed. Bluestone is the sandstone occurring in the northeast part of the state and quarried for flags.

The total output of sandstone is around 1,500,000 tons, sold for $2,500,000. More than half of this is crushed stone and railroad ballast. The flagging industry alone amounts to more than $150,000.

Building stone sold as rubble, riprap and cut stone is produced in largest quantity at Koppel and Wurtemburg near Ellwood City in Beaver County, Neshannock Falls in Lawrence County, and Curwensville, Clearfield County (Fig. 1). These quarries furnish a gray to tan or buff sandstone in blocks of any desired size up to those weighing 2 or 3 tons each for bridge masonry. The output of these quarries north of Pittsburgh is shipped as far east as Philadelphia. The Homewood sandstone of the Pottsville formation is the geologic horizon most used. Large quantities of curbstone are made at Koppel and Wurtemburg for the Pittsburgh district. Curbing is cut also from the Connoquenessing sandstone at Madera, Clearfield County, and from the red Chemung sandstone on Lehigh River near White Haven, Luzerne County.

Bluestone quarry of Degnan & Winans at Auburn Center, Susquehanna County.

Red Triassic sandstone or brownstone is no longer quarried extensively for building stone in this state, the large operation at Hummelstown hav-

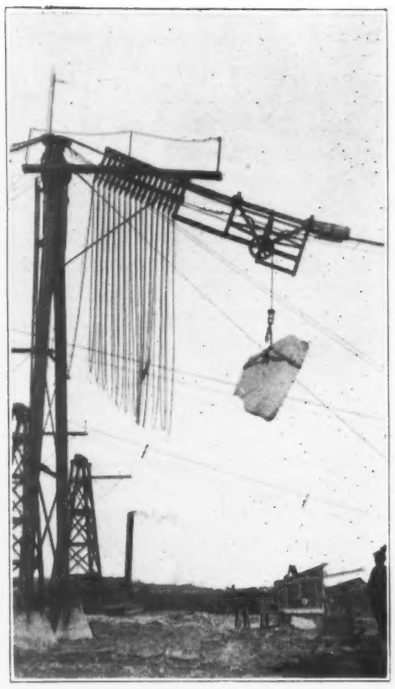
The Frank Holdren bluestone quarry at Durell.

TABLE I.—LIMESTONE SOLD OR USED BY PRODUCERS IN PENNSYLVANIA IN 1929

	Short Tons	Value
Rough building	64,140	$ 87,044
Crushed for concrete and roads	5,277,580	6,127,843
Crushed for railroad ballast	50,570	47,059
Fluxing stone	8,621,270	6,721,767
Glass factories	98,560	177,838
Paper mills	30,650	35,015
Agriculture	67,910	221,083
Other uses	314,400	606,638
Totals	14,525,080	$14,024,287

Marble quarry near Norristown.

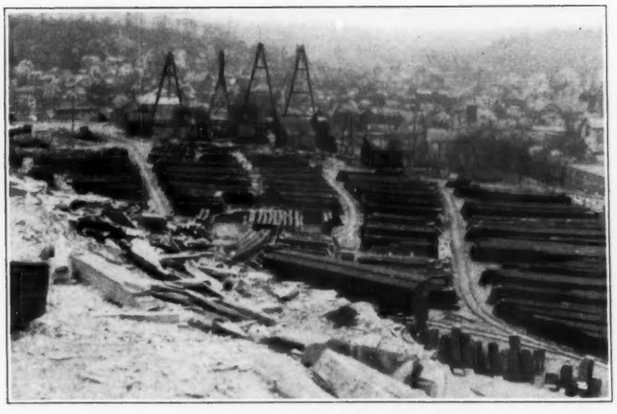
Hoisting a slab of slate.



Bringing in a huge piece of slate.

ing been discontinued in 1928 for lack of demand. Lighter-colored stone is preferred.

Sandstone and quartzite rubble for building purposes is produced in other parts of the state but only in small quarries. Some very attractive and durable stone that dresses well to ashlar of varie-



Stock-pile of roofing slate near Bangor.

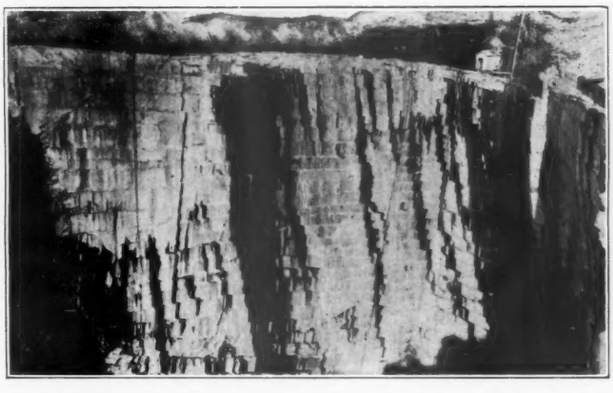
gated color is taken from fields of float on Kittatinny and other mountains without quarrying.

Bluestone in the northeast corner of the state (Fig. 1) has long been quarried for flagging and curbing, but the industry was greatly reduced by the increasing use of Portland-cement concrete. In the last five years, however, there has been a notable revival in demand for this natural stone and a number of quarries are now engaged in its production. The heavy stock is used for ashlar, sills, platforms and other places having transverse strain, common flags are now finding a market for walks and floors, both interior and exterior, in large institutions, public buildings, and private estates, and the very thin flags are now made into roofing shingles, wall panels, and tile to be set in cement. Flagging is also used for base-boards. Broken or irregular slabs, formerly waste, now are sold by the ton for garden paths.

Flagstone has always been broken out by drilling a line of close holes and springing them with plug-and-feather wedges. Most of the drilling is still done by hand, a few quarries using compressed-air drills.

One mill, at Meshoppen, Wyoming County, furnishes flags with natural or rubbed surface, in a variety of tones of red, blue, green and gray, and in any size from tile 1 ft. square to flags for stair landings 7 ft. by 9 ft. and finished on both sides.

Ganister.—Miles and miles of mountain sides in central Pennsylvania are covered with a thick mantle of sandstone and quartzite blocks in great rock floes. These floes are made of rock broken from ledges above, mainly by frost action. The rock is hard and durable, consists almost entirely of grains of quartz, and analyzes high in silica content.



Wall of a slate quarry at Pen Argyl. Colonial Slate Co.

To the beginning of the present century these rock-strewn mountain sides were the most worthless land in the state. Now some of them are the source of material for a large industry, for this rock is used in making fire brick for metallurgical furnaces, lime and cement kilns, coke ovens, and other places requiring a lining that will stay in place and retain its shape under high temperature.

Because the rock on these flows is broken and loose the principal requirement for harvesting it is a light railroad. As the floes lie at a high angle, a light track with switch-backs makes all parts accessible and the rock up to 2-man size can be loaded by hand. Some of the larger blocks may be broken by explosives before loading. The whole operation is one of stripping the surface of the suitable rock by hand selection and loading. When one area is stripped the track may be moved to another floe or, if the distance is too great, the ledge from which the stone was broken by nature's forces may become the site of a quarry. Pennsylvania's output of refractory stone or ganister is more than 500,000 tons annually, valued at close to $750,000.

Sericite schist is quarried in Montgomery County for refractory purposes. The thin slabs, into which it breaks naturally, may be used for lining hearths, or the schist may be crushed.

Slate.—The roofing-slate industry is hard pressed by fire-resistant composition shingles, but less than half the value of slate sold in recent years has been in roofing. Structural and sanitary slate and blackboards together exceed roofing in value. These include slate used for base-boards, laboratory- and billiard-table tops, partitions in shower and toilet stalls, etc. Electrical switchboard panels also add to the volume of business, which in Pennsylvania amounts to about $5,000,000 a year.

The principal slate quarries are in Northampton, Lehigh and Berks Counties close to the great center of the Portland-cement industry. About 2,300 men are employed. The quarries range in depth down to nearly 700 ft. Channeling machines, long used for cutting out large blocks in the quarry floor, have been replaced in part in the last 5 years by the wire saw.

The slate occurs in definite bands along the south side of Kittatinny Mountain and is all blue-black. Both hard slate and soft slate are produced. Besides the uses mentioned above there is a considerable production of school slates, the market for which is largely in Asia, Africa, and South America.

Slate quarrying in Lancaster and York Counties in the famous Peach Bottom district has been discontinued except for one company at Delta which is quarrying and crushing slate to granules for surfacing composition shingles.

Green and red volcanic rocks in South Mountain, Adams County, also are quarried and crushed for this purpose.

Clay.—Probably the first mineral industry in the state was that of digging clay to make brick in the vicinity of Philadelphia. Brick-yards are now widely scattered over the state, but poured concrete seems to be supplanting common brick to a large extent. Shale-brick plants operating in various parts of the state have an abundant supply of raw material. Fig. 4 shows the distribution of clay-product plants and clay sources.

Fire-clay is produced in large quantity for various uses, especially fire-brick and blocks. Its value is a large part of the $2,500,000 reecived for raw clay sold. Fire-clay is mined in the bituminous-coal fields where it occurs under coal beds. The quantity of high-grade clay probably is large but the occurrence is so erratic that reserves can not easily be computed.

It is estimated that the value of clay and shale dug annually and used for the manufacture of brick, tile, etc., but not sold as raw clay, approximates $10,000,000.

Feldspar.—Commercial deposits of feldspar have been worked by open pits in Chester and Delaware Counties for many years. The industry has dwindled, however, until in 1931 only one quarry was operating and that intermittently, crushing spar for poultry grit. The production of crude and ground spar for pottery and other uses ranged from 10,000 to 20,000 tons annually for many years.

Graphite.—Graphite occurring as small flakes in gneiss has been mined in Berks and Chester Counties. In 1918 the production was 1,016,900 lb., valued at $112,059, but production ceased in 1920. Graphite rock, carrying 3 to 4 per cent. of good flake and in some places a higher percentage, occurs in considerable quantity. The rock is so deeply weathered that it has been dug from open pits to a depth of 100 ft.; also it was mined by drifts. Crushing is not difficult and water is readily available, but the greatest difficulty has been that of concentration. New methods have been devised in other states and any future attempt to produce graphite from these deposits would have the benefit of the separation methods perfected since the mining in Pennsylvania was abandoned.

Gypsum.—Although gypsum products are manufactured in Delaware County the raw material is brought from Nova Scotia. There are no deposits of this mineral in the state.

Quartz.—Vein quartz has been quarried in Adams and Chester Counties on a small scale for use in making pottery and false teeth. The output could be considerably increased if the restriction on iron content were not close.

Salt.—Although salt is not produced in the state, thick beds of rock salt are reported in several deep wells. It could be recovered by dissolving with fresh water and raising the artificial brine to the surface by air-lift or otherwise, but the depth of the beds (1,000 to 1,500 ft. in Erie County) prevents their present utilization.

Natural brines from wells along the Kiskiminetas and Lower Allegheny Rivers were formerly evaporated for salt and bromine.

Marl.—Small deposits of marl are known in several places and have been dug by hand or by plow and scraper for local use as a soil sweetener. At least one attempt has been made recently to dig, dry, and market this material, but some difficulty is found in pulverizing it, owing to a tendency for the marl to gum up the grinder.

Proper Use of Hand Tools Will Help to Reduce Lost-Time Accidents*

By G. E. BURNS
Safety Engineer, National Safety Council

EVEN in this age of machinery, many operations are still performed largely, if not wholly, by the use of hand tools. Statistics show that hand tools contribute a large portion of the accidental injuries in industry. For instance, the Bureau of Statistics of the New York Department of Labor shows that 7,389 persons received compensation in one year for injuries from hand tools. The amount paid for loss of time was $1,574,455.

Ordinarily the thought of danger is especially associated with power-driven machines and, although these do cause many accidents, it will be found that a surprisingly-large proportion of accidental injuries in all plants occur in the use of hand tools. The possibilities of injuries in connection with machines are easily apparent, but the progressive manufacturers of to-day, by the installation of practical guards, have reduced these hazards to a great extent. It is different, however, with hand tools; these are apparently quite harmless, and that is one reason why many injuries occur in their use. Mishandling hand tools, neglecting to keep them in proper condition, and leaving them in dangerous places are frequent causes of accidents.

Material.—It is of prime importance that the best material be used for making hand tools. Too often purchasing agents do not realize the hazard introduced by using inferior material, or the actual loss in production and the greater ultimate cost of the tools. As a result the chisels, punches, drifts, etc., made from poor stock soon become dull, and their heads upset, mushroomed, and cracked. There is no economy or safety in buying anything but the most suitable grade of tool steel for hand tools; this does not necessarily mean that it is essential to buy special expensive brands of alloy steels from which all tools are to be made, but that the proper grades should be provided for the various purposes. In every plant careful consideration should be given to determining the proper specifications for steel used under different conditions, and to seeing that these specifications are met. A standard form of steel specification should be attached to every purchase requisition for such material; otherwise it is impossible to place the responsibility for inferior materials upon the purchasing department.

The individual grades of tool steel and machine steel should be carefully marked for identification, and kept in separate storage racks, so that they will not become mixed and used for purposes other than those for which they are intended.

Forming and Tempering.—Probably no one thing contributes more to safety in the use of hand tools than does care in manufacturing the tools, especially proper tempering. Tool steels of different compositions require different methods of treatment. The method selected should depend on the work for which the tools are to be used. Several methods of tempering tools are used for securing different results, each having its own advantages. The most common method is the color method in which the temperature of the metal is gauged by its color. Some other methods are: oil-tempering baths, lead baths, cyanide-of-potassium and barium-chloride baths, sand tempering, and oil-heated furnaces. Various hardening or quenching baths, too, are used for securing different results, such as pure water (at various temperatures), salt water, soapy water, sweet milk, mercury, carbonate of lime, wax, tallow, air (mostly for high-speed steel), and oils. It is possible to temper tools so that the surface is hardened sufficiently for cutting purposes, yet the body is soft enough to prevent fracturing.

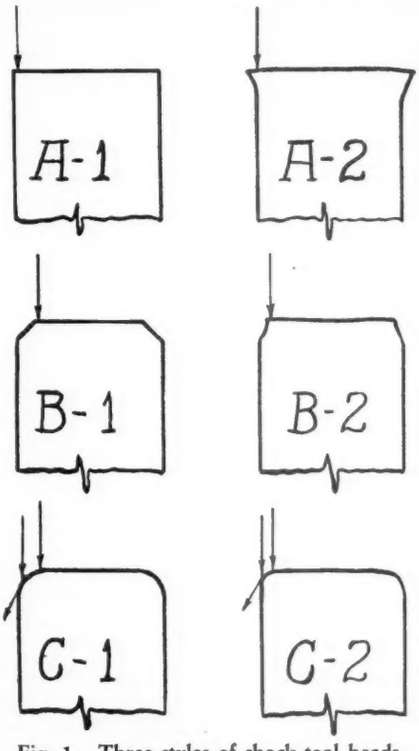


Fig. 1. Three styles of shock tool heads. A and B show heads dressed in more or less obsolete fashion and results after being subjected to continual hammering. Style C, with up-to-date radius, lasts much longer and will practically eliminate the hazard from flying fragments.

Fig. 2. This sledge hammer was found in actual use. Note the chipped head, badly splintered handle, and the nail used.

It is at once evident, therefore, that if the best results are to be had with hand-cutting tools the services of an experienced person are needed in the manufacture of the tools—some one who has a

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knowledge of the peculiarities and characteristics of metal as well as of the advantages of certain processes of treatment. The makers of special steels always furnish instructions for working their particular brands so that where competent men handle the work, no difficulty need be encountered in making and tempering the tools. The directions should be carefully followed except in cases where experience has shown the advisability of varying the method for some specific purpose.

Shock tools, such as chisels, punches, cutters, hammers and sledges, should be made of carefully-selected steel, that is hard enough to withstand blows without mushrooming excessively and still not so hard as to chip or check. From a safety standpoint it is better that shock tools be a little soft rather than too hard, for soft tools can be dressed frequently, whereas a chip may fly from a hard tool without warning when struck with a hammer or sledge.

The penetrating power of a chip is almost unbelievable. Chips from hand tools have even caused fatal injuries where arteries have been cut and the blood flow has been excessive.

Soft hand tools should be dressed as soon as they begin to check. A slight radius ground on the edge of the head of the tool when dressing will cause the tool to stand more pounding and there will be less danger of chips being knocked off head of tool. Tests which have been made seem to indicate that a radius of 3/16-in. is most satisfactory on ordinary hand tools. A curve is also much better than a straight bevel or chamfer. (See Fig. 1.)

Tool Handles.—Frequently companies attempt to realize a saving by buying cheap grades of handles for hammers, drifts, picks, and other tools. The handles of all hand tools should be of the best straight-grained material free from slivers and, preferably, of hickory, ash, or maple. Should a hammer or chisel handle break, some workman may be seriously injured by the flying head. Splintered handles also are a common cause of lacerated hands, especially on picks, shovels, axes, sledges, etc. Buy good handles and keep a sufficient supply on hand in the tool room. (See Fig. 2.)

Many workmen wrap friction tape on tool handles to prevent slipping. Anything that reduces the hazard of tools slipping in the hand should be used.

Particular care is necessary in fitting the handle to the tool. It is advisable that all handles be fitted by an experienced person to make sure that they are properly fitted and securely fastened in place. If workmen are permitted to use nails as wedges for fastening handles the likelihood of injury is greatly increased. (See Figs. 3 and 5.)

Tool-Room.—Mechanics and machinists ordinarily have their own tool kits containing one or more machinists' hammers, calipers, gages, and other such tools. It is customary, however, in most plants for the company to supply all cutting tools such as chisels, as well as sledges, hammers, picks, shovels, etc. Since so many injuries result from chips flying from mushroomed heads of tools, and from hammers and other tools with splintered handles, or handles not properly fitted, it is advisable that there be scheduled inspections of all hand tools by the foreman or crib man.

There are many hand tools which, though belonging to the company, are in constant use by some skilled workman. A good workman takes as much pride and care in these tools as he would in his own personal property. A man of this type should be given consideration, and allowed to keep a few of the company's tools in his own tool box or drawer. To see an unskilled man abuse a tool makes a skilled man's "blood boil" as much as to see a horse whipped. Naturally, there should be a method of checking up these tools. A good man will not resent an inspection, from time to time, of the company's tools which he has in his possession.

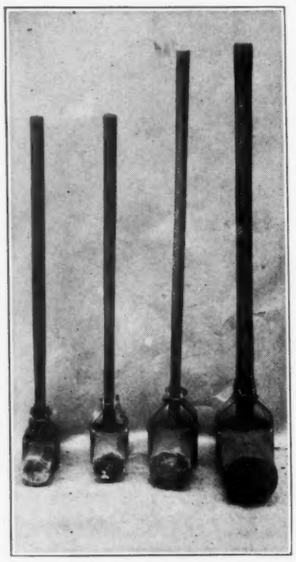


Fig. 3. Sledge hammers used in the plant of the Universal Portland Cement Co., Buffington, Ind. The wrought-iron strap, clamped to the handle with two small bolts, runs completely around the hammer head and is welded to it at the sides.

Fig. 4. Shovels and forks, formerly piled on shelves, are now neatly stored by the Pennsylvania Dixie Cement Corp. By placing the racks well above the floor, useful space is made available below for other purposes.

The tools used by unskilled men should be turned in at the end of each day, inspected by the foreman or crib man, and all necessary repairs made before being checked out again. By this method the company may be sure that only safe tools are in use. (See Fig. 1.)

The tool-room attendants should be held responsible for the inspection and care of all tools and should see that no tool is put into use which has a mushroomed head or an improperly-fitted handle, or is otherwise defective. They should realize the necessity for having all tools in the crib racked safely so that any jarring will not cause the tools to fall from the racks with consequent possible injury to those standing near. (See Fig. 4.)

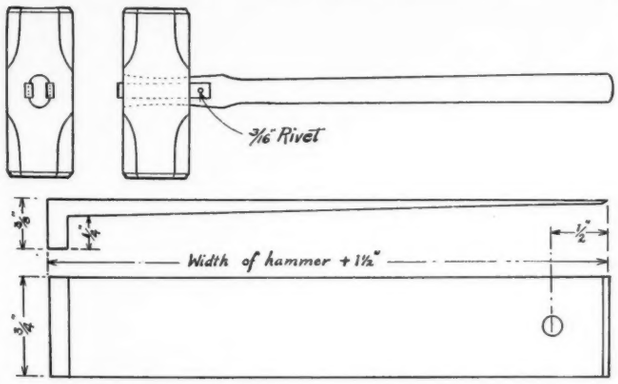
In each tool-room there should be one or more suitable grinding wheels, vises and other equipment necessary for the attendants to use in keeping the tools in repair. In dry-grinding burrs from the heads of tools care should be taken not to burn

the metal at the head of the shank and thus draw the temper.

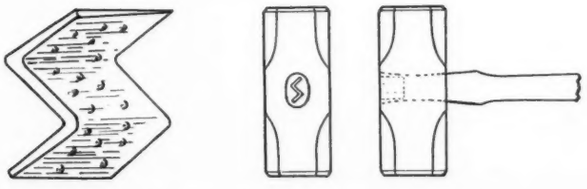
Where tools are tempered in the tool-room, it is essential also that a suitable furnace, fitted with a pyrometer, be provided. Many companies requiring a large number of cutting tools have a heat-treating department in which all tools are tempered, after which they are forwarded to the proper tool-room to be fitted with handles where necessary and distributed to the workmen.

Hammers.—The hammer is the most commonly used of all hand tools and, at first thought, one would not consider it to be the cause of many accidents. There are a variety of types of hammers, each of which is suited to some particular class of work. A machinist's hammer is not suitable for driving nails, nor a carpenter's hammer for machinist's work, nor a cobbler's hammer for a stone mason. The nature of the work is the controlling factor in the type of hammer to be selected. Frequently accidents happen because the wrong kind of hammer is used.

Soft-metal hammers should always be provided for striking tempered or case-hardened tools. To use a hardened hammer on hard steel is dangerous because the tool or hammer may break and a flying particle may strike the workman or some fellow-worker in the eye. Soft hammers for striking tempered or case-hardened pieces of steel are usually



Tapered wedges,- riveted through handle.



"S" wedge,- with roughened surface.

Fig. 5. Sledge-hammer safety wedges. Here are two methods by which the hammer head may be safely fitted to the handle. Glue put on the wedges before fastening aids materially in making a safe and secure job.

of copper, lead, rawhide, or wood. They are sometimes made by taking an ordinary pipe tee, large enough to make a fair-sized hammer-head, putting into the tee a straight piece of pipe, or anything cylindrical and hollow, and molding lead or Babbitt to form a head as desired. The advantage of this method is that the handle will not come off. If it is ever necessary to use hand tools in buildings

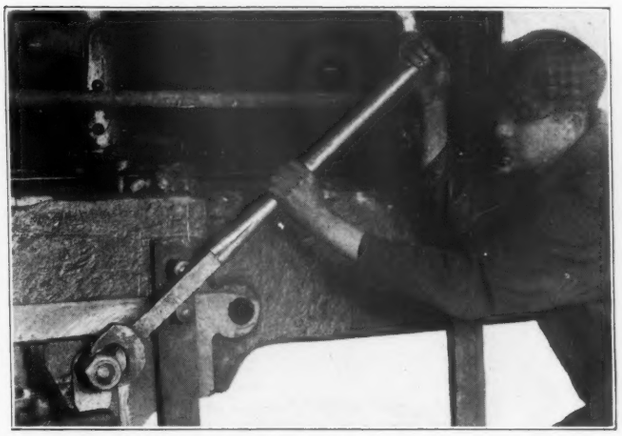


Fig. 6. Note that the wrench opening is too narrow. Also that the pipe used as extension (entirely too long) is badly cracked. Unsafe practices of this kind are responsible for many injuries.

when explosive gases or vapors are present in the air, they should be made of non-sparking materials. This reduces the possibility of sparks, which might cause an explosion or fire.

The unsafe practice of using a battered piece of brass or copper to receive the blow of a hammer, while pounding hard metal or making a drive fit, can not be ignored. Experience has shown that a severe blow will sometimes cause some of the already battered metal to fly off with sufficient force to penetrate a man's body. Only an entirely new piece of brass or copper should be used for this purpose.

The importance of properly fitting a hammer with a straight well-balanced handle of good material is often not appreciated. This is particularly necessary in the case of sledge hammers which are subjected to severe use. Tempered metal hammers which show any defects, such as cracks in the face of the hammer-head, should not be used because of the likelihood of the head splintering and flying particles striking some workman.

Hammers and hatchets used by box-makers and carpenters frequently have a corrugated or bull's-eye driving face to prevent nails from flying when being driven. These hammers have been found by a number of companies to give complete satisfaction. They not only increase the production, but also reduce the hazard from flying nails.

Accidents frequently occur when a workman accustomed to using a hammer of a certain weight attempts to use either a lighter or a heavier one and, as a result, makes a mis-stroke which causes an injury. It is desirable, therefore, that each machinist or workman use his own type of hammers with which he is familiar. In plants where sledge hammers are used, a standard weight hammer should be decided upon for certain classes of work, and only hammers of that weight should be distributed to those workmen.

Wrenches.—Many injuries result daily in the use of wrenches. Workmen try to use a wrench of a larger or smaller size than the nut which they are tightening or loosening, with the result that the wrench slips and the workman suffers an injury.

Frequently also the jaws of the wrench are spread so that it will not hold the nut. Occasionally when a wrench is too large for the nut, some workmen will use a piece of wood, a nail, or some other thin object as a shim. This is decidedly an unsafe practice and should be prohibited. (See Fig. 6.)

Wrenches should not be used as hammers. This weakens the wrench, which causes accidents. The tightening or loosening of nuts on material fixed in lathes or other machines while in motion is another bad practice. This often breaks the wrench or causes material to pull out, resulting in serious injury.

Adjustable wrenches should be placed on nuts the right way—that is, by facing the wrench forward in the way the handle is to be turned. This prevents spreading of the jaws. (See Fig. 7.)

In purchasing nuts be sure that they are of standard type or brand. A percentage inspection of bolts and nuts should be made to insure their conformity to the standard necessary for the plant's demand. A slight variation may be the cause of open-end or socket wrenches slipping and causing accidents.

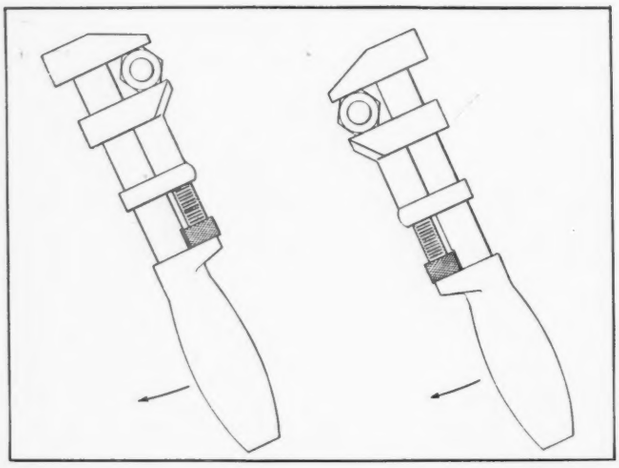


Fig. 7. The example on the left shows the incorrect method of using a monkey wrench. In this position the jaws are weakened. The correct method is shown on the right.

There are several makes of safety wrenches on the market for opening drop-bottom cars. The ordinary wrench should not be used, as it is likely to fly around and strike the man using the wrench when the drop-bottom falls with the load on it. (See Fig. 8.)

It is important to provide good wrenches of the proper design and in proper sizes. It is equally important to keep close watch of the wrenches to see that defective ones are not used. All wrenches, if used by unskilled men, and if furnished by the company, should be turned in at the tool-room each day so that they may be kept in good condition. Defective wrenches, such as those with spread jaws, battered jaws, crooked handles, monkey wrenches with the handles broken off, or any that are otherwise defective should not be put into use.

Many accidents are the result of workmen using a wrong type of wrench, one not suited for the job in hand. Plumbers and pipe fitters should be provided with several sizes of pipe-wrenches. Men doing general repair work should also have selected sizes of pipe-wrenches as well as monkey-wrenches, socket-wrenches, open-end wrenches, and the like.

Particular attention is necessary in regard to the care and condition of pipe-wrenches. The corrugations on the jaws should be kept well-sharpened, and the jaws should be neither cracked nor broken. Another important feature to be watched is the condition of the "nut-holders" and springs. A cracked nut-holder may easily cause an accident. In the use of chain-tongs the hazard of a breaking link is present. The first link, near the jaw, will bear close watching, as it is here that the signs of strain show first. In using both pipe-wrenches and chain-tongs care must be taken to obtain a good firm "purchase" before trusting any weight on it.

Hatchets, Axes, and Adzes.—Keen-edged wood-cutting tools, such as hatchets, axes, adzes, etc., should always be kept sharp as a sharp tool is safer and more efficient than a dull one. It is important also that the handles of this type of tool be of the best material and carefully secured in place. Accidents in the use of these tools are frequently due to workmen leaving them lying about where they are stepped on or struck against. Workmen must be continually warned in this regard. A good practice is to drive the tool when not in use, in a block of wood so that the cutting edge is imbedded. For carrying such tools leather cases are often provided. Where such cases are not available, however, the safe practice is to carry the tool with the head in front and with the hand gripping the handle directly behind the head. (See Fig. 9.)

Knives.—The use of knives results in many injuries in industry. By the use of special carrying pouches and improvement in handle construction many concerns have made reductions in the number of injuries from this source. Some of the knives

Fig. 8. Safety wrench for opening bottom-dump hopper-car doors. Hinged jaw permits wrench to release without injury to the man when the shaft spins around. Disk on wrench handle guards hands against injury from striking side of car.

have a metal clip set in the handle to prevent the hand from sliding up on the blade, while others are equipped with finger rings and loops.

Saws, Draw-Knives, Etc.—On account of the sharpness of wood-working tools workmen frequently have their hands cut by striking against the cutting edge. Inexperienced persons sometimes cut their forefingers or thumbs when starting a saw cut. It is advisable to make the first stroke of the hand saw upward. This gives a start into the wood with less chance of the saw jumping. There is little or no danger in the use of hand-planers, but it is suggested that, when not in use, they be put back in the tool-box. No workman should attempt to use a draw-knife with his knees bracing the work. If used in this way, the draw-knife may slip and badly cut his knee. (See Fig. 10.)

Wood chisels should be provided with good substantial handles. Where a mallet or hammer is used for striking the end of a chisel handle, it is a good practice to put a metal band around the end of handle to keep it from spreading.

Pliers, Wire-Cutters, and Tongs.—Pliers and wire-cutters are not ordinarily dangerous. Men

Fig. 9. Woodsmen should be instructed to carry an axe at the side with the head forward.

working on electrical circuits, however, frequently suffer electric shocks when they touch live circuits with their pliers or other hand tools. It is thought by many that tape or fiber on the handle is sufficient insulation. Tape gives a better gripping surface, but it is usually safer to use good rubber gloves. When cutting wire under tension, or spring wire in coils, always take hold of the wire close to the cutters, and stand so that the other end can not fly into the face.

Records in many plants show that injuries have been caused, especially in black-smithing operations, when the handle ends of the tongs have severely pinched the user's hand and fingers. To reduce this hazard the handle ends should be so shaped that they will come together, when the tongs are closed, but will leave sufficient gripping space between the handles to protect the workman's hands. (See Fig. 11.)

Chisels (for cutting metal).—Several different methods of safely holding chisel cutters, cold chisels, and bull-chisels have been developed by various companies. In the use of such tools the necessity for the men to wear goggles is imperative. Flying

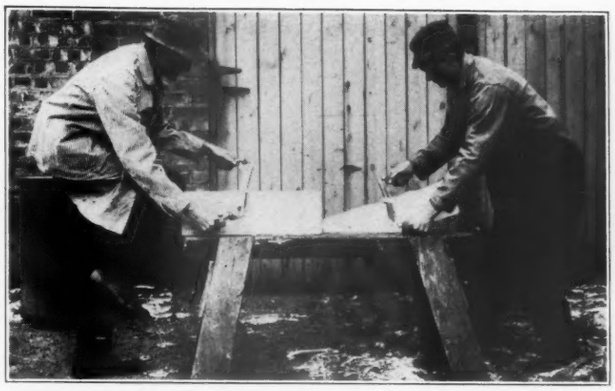


Fig. 10. Unsafe and the safe methods of using a draw knife. The man on the left is in danger of cutting his knee should the knife slip or cut through the wood too quickly. The man on the right is at a safe distance from the board, which is securely clamped to the wooden horse.

pieces of steel, concrete, etc., may cause severe eye injuries. The importance of proper tempering and inspection has already been mentioned. One method of protecting the cutting head of a chisel, when removing a rivet, is to fasten a screen guard to the body of the chisel.

Shovels.—It is important that every shovel be fitted with a good, strong, smooth handle so that workmen will not have their hands cut by splinters in the shovel handles. Shovels should not be left lying about the job where they will trip workmen or be bumped against and possibly cause cuts to feet or ankles. It is better that they be carefully stacked up, or stuck in the ground so that the handles stand upright. They should not, however, be stuck in the ground where they are likely to be run against. Shovels should be turned into the tool-room, where they should be inspected for defects and kept stored in a proper rack. (See Fig. 4.)

Pick Axes.—It is of importance that the handles of pick axes be kept in good condition, smooth, and securely fastened. Some severe injuries have occurred when the head of the pick, at its highest point over the workman's head, has slid down the handle and struck his head or pinched his fingers. While it is important to keep the points sharpened, it is equally important to have them properly heat-treated. From a safety standpoint it is much safer to have the point wear off than break or chip off.

Hooks.—Freight handlers have become adept in the use of the hook. In a few instances, particles may fly off some hard object and strike other persons in the eyes, or the hook may glance off some hard object and injure a person. Another hazard is carrying the hook in the belt with the sharp point exposed. It may injure either the man who carries it, or other persons who brush against him.

Hooks for handling logs and lumber, such as cant-hooks, peavies, and pickaroons, should be kept sharp at all times. It is much less dangerous to use sharp tools of this kind than dull ones. It is advisable to inspect these tools daily to be sure they are in good condition.

There is one caution common to shovels, picks, and forks. Where two or more men are using these

tools on the same job, care must be taken that they are stationed so that they will not strike each other.

Crowbars, Car-Movers.—The principal hazard to workmen using crowbars is that of the bar slipping, causing the workman to be thrown against the ground or some object. Crowbars should be kept in good condition, as one with a dull, broken end is more likely to cause trouble than a sharp one. Workmen should not lean a crowbar against a flat surface because the vibration of a building or a person unintentionally striking it might cause it to fall and injure some one. Always lay a crowbar, chisel bar or other similar tool down on the ground, floor, or platform. If laid on an elevated floor or platform care must be taken that it can not roll or be kicked off. Never lay a bar down across a passageway or where others can trip upon it and fall.

For moving cars on steel rails the use of crowbars is not advisable. There are several types of car-movers available, and these are much safer than crowbars for this purpose. Some companies have attached a disk or block to the handle so that there is clearance between the bar and the rail for a man's hand when the bar comes down on the rail.

Lifting Jacks.—Due care must be taken, naturally, to use jacks of sufficient strength. It is sometimes worth while to place a piece of wood between the head of a jack and the load that is lifted, to prevent slipping of the jack from under the load. Improper centering of the load upon a jack often causes the jack to kick out, resulting in serious injuries. In some cases men have been killed due to their being thrown off of buildings by the kick of the jack. Injuries sometimes occur when a workman's hand is pinched by the falling head of a lifting jack. Care must be taken that hands and feet are in the clear when a jack is released.

Jacks should always be set on a solid footing or they may shift and cause the load to fall. No one should ever get under an object (such as a car, engine, etc.) supported only by jacks. After the object is lifted to the desired height horses or blocking of sufficient strength should be placed under it before work is started. Jacks, whether mechanical, electrical, pneumatic, or hydraulic, should be equipped so the operator will not be exposed to injury should the lifting mechanism fail while under a load. This refers specifically to mechanical jacks where the safety pawls have been known to release, allowing the jack handle to fly up and strike the operator, often causing serious injury.

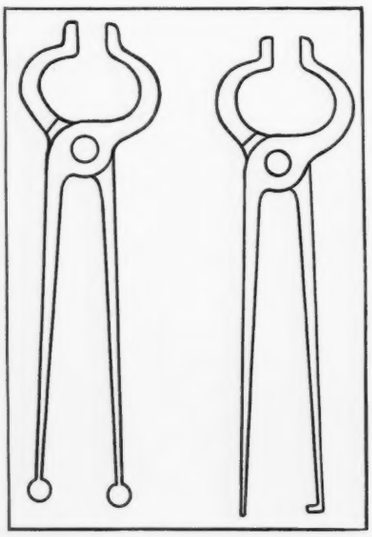


Fig. 11. When the ends of the tongs are upset or angled, fingers can not easily be pinched.

Screw-Drivers.—Screw-drivers present but little hazard in their use, but all screw-drivers should be provided with good handles for protection of the workman's hands. Further, the points of the screw-drivers should be kept in good condition so that they will not slip. Insulated handles on screw-drivers for work around electric circuits are often used as an added safety feature. The practice of holding the screw-driver in one hand and the material to be worked upon in the other is decidedly unsafe. If work is done in this manner, a pierced hand is often the result, caused by the slipping of the screw-driver from the screw slot.

To reduce the hazard of slipping, screw-drivers are now being manufactured with a ribbed point. The ribbed points or serrations engage the inside of the surface of the screw slot and thus the point is locked in the slot, somewhat after the fashion of the meshing of gears.

A screw-driver presents several hazards when used as a makeshift tool for other than its intended purpose. This practice renders it unfit for its special purpose as a screw-driver. The shank often becomes bent from use as a punch bar. The points become rounded and worn and readily slip from the screw slot. The handle becomes split and splintered from hammer blows when used as a chisel. A roughened or splintered handle is likely to form blisters on the hands of the user, in which infection may develop. The slipping of a screw-driver from a screw head while the user was pressing hard against it has even caused the loss of an eye and other head injuries, because the sudden release has made the worker lunge forward and strike his head on some near object. Inguinal ruptures have also been caused through bruises to the body when the driving points have suddenly released from the screw slot.

Lightweight Materials Described in Bureau of Mines Reports

Among recent trends in building construction is the rapid introduction of lightweight materials, the efficient use of which permits appreciable savings in total building costs. Furthermore, the heat and sound insulating, fireproofing, and acoustical properties of many of these products are especially good. Most of these materials are directly related to the nonmetallic-minerals industry and a series of reports describing their manufacture, properties, and uses is now being prepared by H. Herbert Hughes, Building Materials Section, United States Bureau of Mines.

The first of these papers is a general summary of the entire field. Various lightweight building materials now on the market are discussed briefly. Succeeding reports will be devoted to a detailed description of an individual material or group of materials. The tentative outline for the series includes burned shale aggregates, cinder concrete, slag concrete, sawdust concrete, aërated concrete, natural volcanic rocks, gypsum products, ceramic products, and mineral wool.

New Sand-and-Gravel Plant Designed to Meet Present Market Demand

Modern Engineering Practice Is Reflected in Processing Methods of Cincinnati Unit

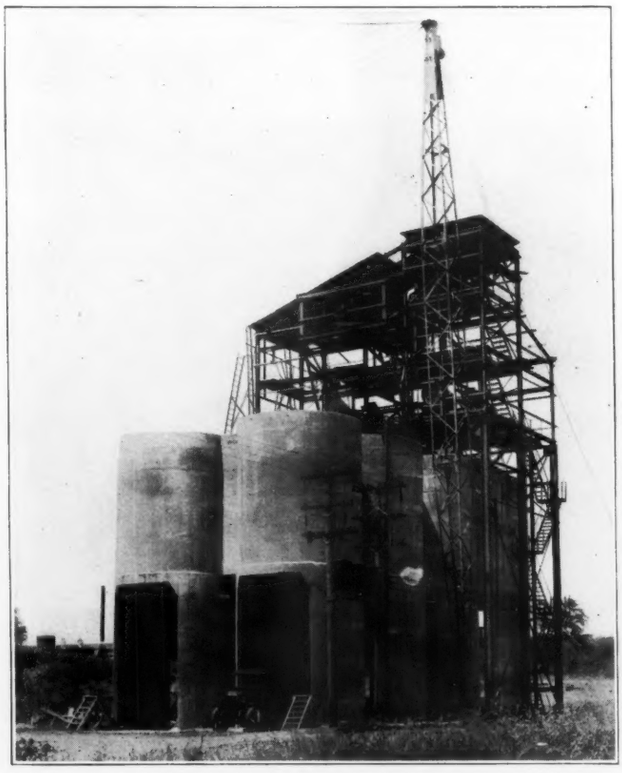
THE growing importance of Cincinnati as an industrial center and its favorable outlook for construction and engineering work were the two principal reasons which prompted the owners of the North Cincinnati Sand & Gravel Co., Inc., to build a new $60,000 modern sand-and-gravel washing plant at Vine St., opposite the Carthage Fair Grounds, Carthage, according to *The Building Witness*.

The owners of this new, up-to-date aggregate plant, which has just been placed in operation, expect it to win a large share of the sand-and-gravel business from Cincinnati contractors because of its location. Being only 6 mi. from the heart of Cincinnati, it is said to have the advantage of being the city's closest gravel-washing plant. Since speed is one of the major factors in the completion of a construction project, the material or gravel plant that is closest to the job has a good chance of landing the order, because of its lower delivery cost.

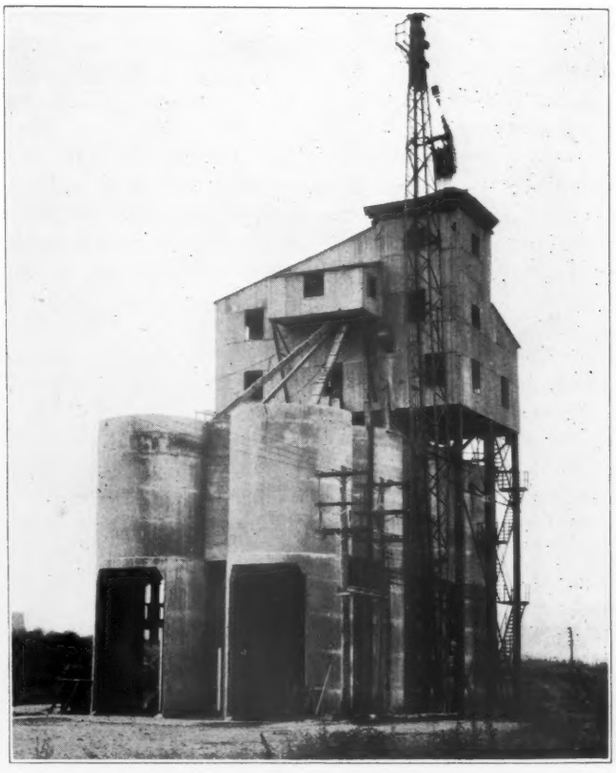
The North Cincinnati Sand & Gravel Co. was organized in December, 1929, by J. F. and William Bushelman, two brothers who are well-known figures in the construction industry of Cincinnati and especially the Millcreek Valley district. At first this company acted as sales agents for a sand-and-gravel plant located in the valley. In spite of the fact that building operations were at a very low ebb, the North Cincinnati Sand & Gravel Co. met with success from the beginning, and had little trouble in disposing of the output of the plant with which it was connected. This good start in business led the owners to consider the possibilities of a plant of their own. After considering the possibilities of sites for their own plant throughout greater Cincinnati, they at last came upon their present location which consisted of a tract of 20 acres of a high-grade deposit of sand and gravel.

In February, 1931, the Bushelman brothers took an option on their present plant site and joined hands with Joe Merkle and Herbert H. Mueller. The North Cincinnati Sand & Gravel Co. was reorganized and incorporated with Mr. Merkle as president, Mr. Mueller as vice-president, J. F. Bushelman as secretary-treasurer, and Wm. H. Bushelman as general-manager.

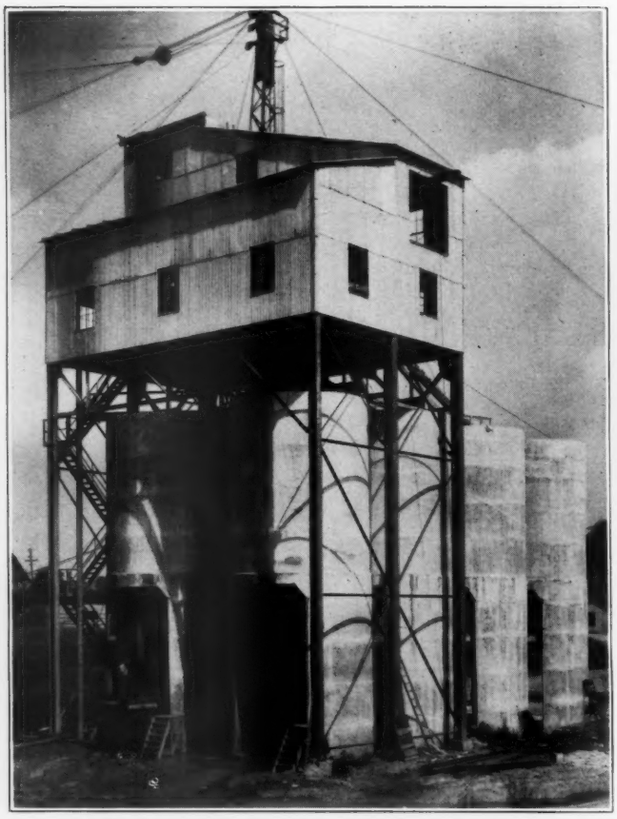
The deposit of this new plant is regarded by testing engineers as exceptionally rich. There is a known depth of at least 40 ft. of well-graded material of high quality. The raw material is exca-



Plant before being inclosed with corrugated sheathing.



A completed view showing compact construction.



Another plant view showing truck being loaded at the left.

vated by means of a Street Bros. slack-line cableway equipped with a 1-cu. yd. bucket. Entry of the material to the plant is made by the bucket's discharge to a 40-cu. yd. steel hopper located at the top of the plant structure.

To incorporate modern engineering practice in the design of its plant structure as well as in the selection of processing machinery, the North Cincinnati company selected the Raymond E. Church Engineering Co., Cincinnati, O., placing the latter firm in complete charge of design and erection. The plant, as completed, is representative of the simple, yet efficient, design so characteristic of recently-built plants. Steel-and-concrete construction makes the new structure totally fireproof as well as permanent.

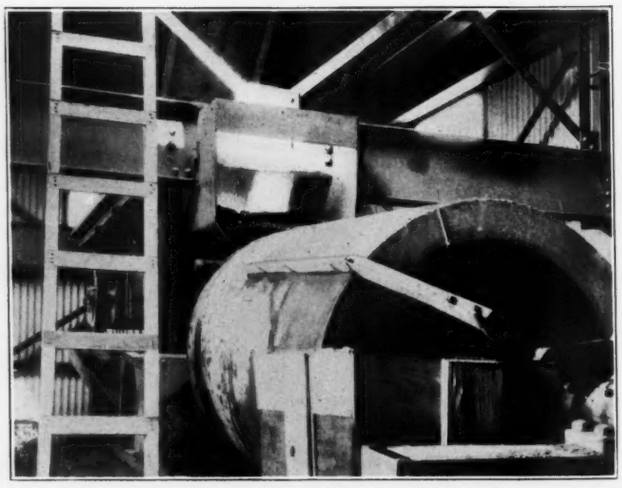
The new plant consists of a concrete silo structure for the storing and loading of aggregates and a steel superstructure which supports and houses the processing equipment. The silo structure consists of two parallel rows of concrete bins, four silos to a row, with three bins between, each having a capacity of 150 cu. yd. Driveways underneath the two rows of bins allow truck loading directly from each bin, and provisions have been made for the extension of railroad sidings on two sides. The concrete silos were designed by the Gifford Wood Construction Co.

Inasmuch as this plant is located within the city limits of Cincinnati it was necessary to construct it in accordance with the city building code. While it was originally planned to place the steel structure directly on the silos, the building code would not permit such construction. It was, therefore, necessary to support the superstructure independently of the silos. This was accomplished by the use of six 14-in. H-columns which carry three angle trusses over the silos. These trusses support the building columns, which are spaced on 15-ft. centers in both

Some of the vibrating screens and a bucket elevator.

directions. All machinery is supported directly on the steel work, except the crusher, which has a 4-in. hardwood cushion above the steel supports. The vibrating screens for gravel are installed in a well, in such a manner that the supporting frame for the screens can be lowered for easy removal. A 3-ton monorail hoist is provided for handling machinery from the plant to the ground or inside the plant. Steel windows are installed in every bay so that ample light is provided in the entire plant.

Following the materials-flow line, the raw material is received in the 40-cu. yd. hopper, which is guarded from large boulders by a flat-rail grizzly having 8-in. free openings. From the hopper the



Revolving scrubber and reciprocating feeder. The ladder leads to the top of the hopper.

material is handled by a Columbus Conveyor Co. reciprocating feeder which delivers it to a Columbus revolving scrubber. Both units are driven by a 7½-hp. Wagner motor.

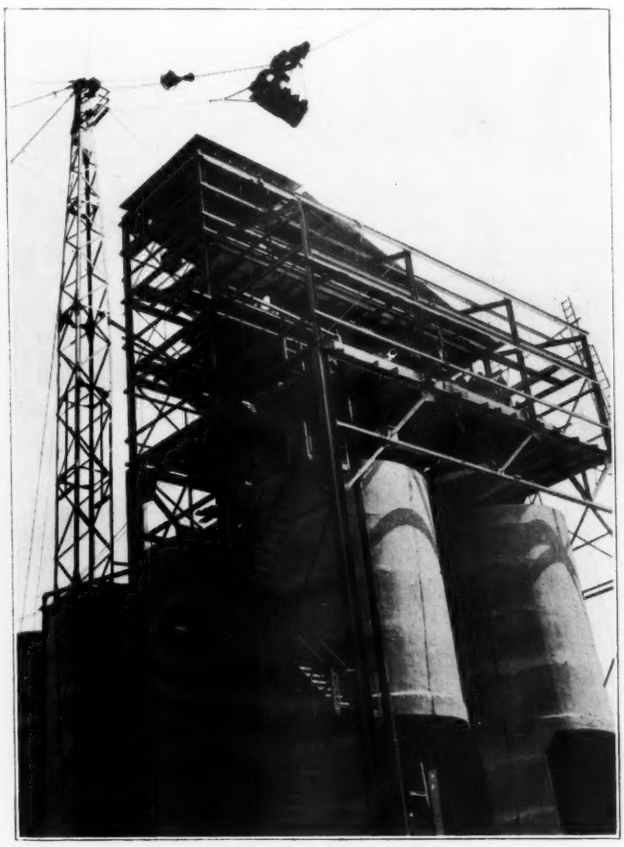
The material from the scrubber is discharged to

a 2-deck Deister vibrating screen, equipped with 1½-in. wire-cloth top deck and 1-in. wire-cloth bottom deck. The minus 1-in. material is discharged to a 3-deck Deister Plat-O vibrating screen, equipped with a ¾-in. wire-cloth top deck, a ⅜-in. wire-cloth intermediate deck, and a 3/16-in. wire-cloth bottom deck. With this arrangement any special and standard size gravel can be produced, either by remixing at the discharge end of the screen or on the reclaiming belt which will be described later.

The plus-1½-in. gravel is spouted to a 12-in. by 20-in. Universal jaw crusher, driven by a 30-hp. Wagner motor. The crushed material is then elevated to the top of the plant by a Columbus bucket-elevator to a 3-deck Deister Plat-O vibrating screen, where it is screened dry, the "oversize" being returned to the crusher. Provisions have been made at the head of the elevator to return a part of or all the crushed material to the top gravel screen.

The minus-3/16-in. sand passes to a flume where it is split as follows: ⅛-in. to 3/16-in. sand, 1/16-in. to ⅛-in. sand, and minus-1/16-in. sand, which can be remixed in any sizes desired. The sand is dewatered by three Columbus drag-type sand-settling tanks, driven by one 10-hp. Wagner motor. These drags are arranged with jaw clutches so any of them can be put out of operation when producing unsplit sand.

All finished material is spouted direct to any of the eleven storage bins. Provision has been made for a reclaiming-and-remixing belt-conveyor underneath the three center bins, so arranged that material can be withdrawn from any of the eleven bins and remixed in any proportion.



Looking up at the steel work during construction. Cableway bucket and receiving hopper above.

The plant is also equipped with a 3-cu. yd. Butler weighing-hopper, having three scale beams, and arranged to receive material from three bins.

Water is supplied to the washing plant from an open pit by a Worthington centrifugal pump, having a capacity of 800 gal. per min. It is driven by a 50-hp. squirrel-cage motor. All waste water is returned to a sump, where it is allowed to settle before flowing back into the pump pit.

All motor controls are centralized on the first floor, with emergency stop buttons located at several convenient points. Steel stair-stringers with 2-in. wood treads lead from the ground to the first floor, and also from the first to the second floor and from the second to the third floors. The total height of the structure, from the ground to the top of the hopper, is 85 ft. Ample headroom has been provided for any changes that may prove to be desirable with the changing specifications of sand and gravel.

Lime Plant Uses Oyster Shells

(*Continued from page 24*)

possible by the special burning and hydrating methods used. The finished hydrate goes to a steel storage-bin of 20-ton capacity which feeds the Bates 2-bag packer. This building also has ample storage capacity for sacks and sacked lime. Bates multi-wall paper bags are used exclusively.

The plant is entirely of concrete-and-steel construction and all the buildings are inclosed with corrugated sheet-asbestos siding. It was designed entirely by the company and erected by its forces. All conveyors and elevators and their housings and drives were furnished by the Bodinson Mfg. Co.

The kiln is driven by a 15 hp. motor through a Goodyear drive-belt and gear. The cooler is driven in the same manner by a 5-hp. motor which also drives the elevator feeding the cooler. The hydrator is driven by a 7½-hp. motor through a DeLaval worm-gear speed-reducer. The packer and Raymond mill are direct-driven by 10-hp. and 7½-hp. motors, respectively. United States electric motors are used exclusively.

Erection of the magnesium-hydrate plant at Newark will probably be begun this year and, when it is in operation, it will use the entire output of the present lime plant. At that time the company intends to build a new and larger lime plant alongside the present one to take care of the growing commercial demand it has developed during the past year.

The California Chemical Corp., in addition to its plants at Newark and Porterville, also operates a bromine and magnesium-chloride plant at Chula Vista, Cal. This plant also uses bittern as a source for these products. Chula Vista is a few miles from the Pacific Coast between San Diego and the Mexican border.

This company is under the same management as the Sierra Magnesite Co. which operates the magnesite mine and calcining plant at Porterville.

Pre-Mixed Concrete from the Engineer's and Architect's Viewpoint*

By H. D. JOHNSON, JR.
Designing Engineer, Bureau of Bridges, Pittsburgh, Pa.

PRE-MIXED concrete in the sense that the word is used in this article is concrete which is produced by one of the following methods: (1) Centrally-mixed concrete, where the concrete is proportioned and mixed in a central plant and then hauled to the job, or (2) truck-mixed concrete, where the concrete is proportioned at a central plant but is mixed in the truck either while in transit to the job or after arrival. Concrete of this class has been produced commercially in the United States for about ten years, and during the past five years its use has become general throughout the country. The general experience with pre-mixed concrete has been satisfactory, but there are several problems which must be solved before all the advantages of its use can be realized.

When the engineer or architect is confronted with the proposal to use pre-mixed concrete, a number of questions come to his mind, these can be placed into two general classes: (1) "Will the concrete be as strong, durable, and workable as job-mixed concrete?"; and (2) "What is an equitable method of payment, which will protect the owner against inferior concrete and still will not work a hardship on the manufacturer?" These questions are the foundation of all contractual relations between the purchaser and vendor, and upon their satisfactory answer depends the success of pre-mixed-concrete operation.

Among the questions that the pre-mixed-concrete manufacturer must answer to convince the engineer or architect that he can make good concrete, are the following:

1. Does the plant maintain facilities for the inspection and testing of cement and aggregates?
2. Can the company furnish concrete according to water-cement-ratio specifications?
3. Can the company furnish concrete in sufficient quantities for large pours?
4. What effect will hauling have on the strength and workability of concrete?

There are numerous other questions which may come up; these are only typical ones. The plant desiring to sell centrally-mixed or truck-mixed concrete to the discriminating and conscientious engineers and architects of today must not only be able to answer these questions, but must be able to prove that the answers are correct.

To meet present specifications which are wholly or partially based on the water-cement-ratio theory of mixing concrete, the plant of today must have modern equipment and a trained personnel which thoroughly understands the basic theories of making good concrete.

Many manufacturers of pre-mixed concrete provide an inspection service, either from outside sources or within their own organizations, to test all cement and aggregates and concrete when desired. An adequate inspection service should cover the sampling and testing of cement, the testing of aggregates (including a test of the grading), the determination of the correct proportions for the various mixes specified, adjustment of mixing water for the moisture content of the aggregates to maintain a definite water-cement ratio, and frequent representative samples should be taken of the concrete and tested at 7 and 28 days for checking purposes.

The equipment for measuring the various ingredients must be accurate and, for a commercial pre-mixed-concrete plant, must be capable of quick adjustments for size of batches. The city of Pittsburgh, after a great many experiments with various types of equipment for measuring cement and aggregates, now specifies that all cement and aggregates must be weighed. A great advantage of weighing batches is that they can be quickly checked for accuracy. The requirement to weigh cement is reasonable and provides the only satisfactory method of measuring the cement if it is desired to mix exact quantities of concrete which require odd weights of cement per yard or per batch.

The question of meeting water-cement-ratio specifications is comparatively simple with modern equipment if—and here is the rub—the manufacturer has someone in his organization who understands the method and knows how to put it into practice on a large scale. It is one thing to make a laboratory batch of concrete and get a predetermined strength, and it is quite another to turn out 3,000 or 4,000 cu. yd. of 3,000-lb. concrete with an average strength of some 3,300 lb. per sq. in. and to have 75 to 80 per cent. of the cylinders within 20 per cent. of the average strength.

Plant capacity is a question for the individual operator to answer for himself. If he desires to service only the small building jobs in his district, his needs will be vastly different from those of the man who wants to serve the largest construction jobs with individual pours of 700 to 1,000 cu.yd. in 10 hr. In a district that is spread over much territory it may be more advisable to establish several small 1- or 2-cu.yd. plants than to install one big plant.

As far as the effect of hauling concrete on its workability and strength are concerned a great deal has been written, many tests have been made and are still being made. In the Bureau of Bridges of the City of Pittsburgh we have found that the strength of our mixes increases slightly during the haul, whether they are hauled in agitator or in

* Address at National Ready Mixed Concrete Assn. 1931 annual meeting at St. Louis, Mo.

plain trucks. The workability of the concrete usually decreases when hauled in open trucks, due to the evaporation of the moisture in the concrete, but, when agitated during transit, our tests indicate that, up to 45 min. hauling (which is as far as our tests have gone to date), the workability increases somewhat with mixes that have a 3- to 4-in. slump at the beginning of the haul. The increase is not so noticeable in mixes of greater or less initial slumps.

As an example of the questions that may be asked of concrete manufacturers, how many operators of truck-mixer companies could answer this question which was recently put to a Pittsburgh operator. "Is the concrete from your truck mixers uniform in consistency, workability, and strength, whether sampled from the front, middle, or back of the truck?" The first answer given was to the general effect that the concrete was well mixed and that it would be uniform throughout the batch. A test was proposed, using this company's standard 1-2-4 mix with 3-in. gravel and the whole operation was carried out in accordance with its usual procedure. The slumps varied from 1 in. to 9 in., and the strengths at 28 days varied from 975 lb. to 3,730 lb. per sq. in. I do not know who was the more astonished, the manufacturer of the concrete or the engineer. Proper supervision can correct such variations, and that was what happened in this instance. A second test, in which the engineer specified the mix, grading of aggregates, amount of water, and mixing time, gave slumps from 3 in. to 5 in., and 28-day strengths from 2,955 to 3,450 lb., limits which should be acceptable to anyone.

The second class of questions, "What is an equitable method of payment for concrete mixed according to water-cement-ratio specifications?" is not as readily answered at the present time as are those questions which deal with the concrete itself. Payment for a predetermined mix, such as 1-2-4 with a specified amount of water per sack of cement, is easily decided upon, and the contract between the producer and the buyer can specify whether the quantities shall be those as mixed or shall be as measured in place.

However, suppose that an architect wants 1,000 cu.yd. of 2,000-lb. concrete. He has designed his structure throughout on the supposition that he will receive 2,000-lb. concrete. The cost per cubic yard of such a concrete is not difficult to determine. Let us suppose, however, that the tests on the first 200 cu.yd. show only a 1,500-lb. strength; should the architect recommend payment for this 200 cu.yd., either at the full price or at some reduced price? The concrete does not meet the specifications, but due to the fact that the remainder of the concrete has been poured while waiting for the 28-day test of the first pour it is impracticable to reject it.

The suggestion has been made that the pre-mixed-concrete manufacturer could arrange with a bonding company to furnish a bond to guarantee that the concrete will meet the specifications, and, while I admit that the likelihood of meeting the specifications is much greater if a concrete manufacturer has a hard-boiled insurance firm keeping an eye on him, the question still arises as to what is the extent of the indemnity due to the buyer if the concrete fails to meet the specifications.

In the aforementioned case, suppose we say that the architect agreed to pay the manufacturer three-quarters of the original contract price for the 200 cu.yd. which failed to meet the 2,000-lb. requirements, and subsequent tests showed that the next 200 cu.yd. had an average strength of 2,500 lb., bringing the average strength of the 400 cu.yd. to the specified strength. Should the architect recommend the payment of 125 per cent. of the contract price for this last pour because it was a better grade of concrete? Decidedly no. Since the structure had been designed for 2,000-lb. concrete the additional strength of 500 lb. is of no use, particularly so since the concrete is supported by only 1,500-lb. concrete.

I have no definite answer to this question, but I feel that strength specifications should be so written that a certain tolerance in the variation of strengths be allowed, and I know of no better tolerance than that suggested by Mr. Walker several years ago, "that 75 per cent. of the tests shall be within 20 per cent. of the average strength, and not more than 5 per cent. shall fall below a predetermined minimum value." With good curing conditions it would be safe to base this criterion on the 7-day strengths instead of the 28-day strengths, thus allowing earlier corrections of irregularities.

I believe that the manufacturer should furnish a bond to indemnify the buyer for defective concrete in so far as it affects the safety of the structure as determined by an unbiased report by a board of disinterested engineers, the manufacturer to pay for this engineering service, but the board to be chosen jointly by the buyer and the manufacturer in accordance with customary arbitration usage.

The Bureau of Bridges and Structures of the City of Pittsburgh avoids all such controversies, either in regard to the quality of the concrete or to the question of payment if the concrete is not as specified, by establishing a very thorough inspection service which follows the production of concrete, from the testing of cement and barges of aggregates through to the breaking of the concrete test-cylinders.

We have been using pre-mixed concrete for a little more than five years. Approximately 45 per cent. of the contracts involving the use of concrete have been served, either in whole or in part, by pre-mixed concrete. Until November, 1930, the bureau had used 10,990 cu.yd. of pre-mixed concrete, which is some 27 per cent. of the total concrete poured. The difference in percentages between the number of contracts and the number of cubic yards shows very clearly that on the majority of the small jobs the contractor preferred to use pre-mixed concrete to setting up his own plant.

Our experience has run the gauntlet of specifications and types of plant and equipment and covers most of the developments in the theory and prac-

tice of concrete making which have appeared in the past five years. The original City of Pittsburgh specifications for concrete provided for a 1-2-4 mix with a total of 6 gal. of water per sack of cement. There were no requirements for the correction of bulking of aggregates, and no tests were made to determine the amount of water contained in the sand and gravel.

A 6-sack batch was assumed to yield 1 cu.yd. of concrete, and, as can be imagined, our calculated quantities came far from checking with the pre-mixed-plant shipping lists. Concrete was hauled in open, flat-bottomed trucks, and workability was lost during the haul. For all these reasons the quality of the concrete poured at this time was inferior. There was no uniformity in strengths or workability. The average strength of pre-mixed concrete for bridge work was 2,525 lb. per sq. in., with a range from 1,307 lb. to 4,138 lb.

Changes were made in the specifications, adopting the calculation method for determining mixes by the use of the fineness modulus, and definite tests were made to determine the amount of moisture in the aggregates in order to hold the water-cement ratio at eight-tenths. An improvement in the strength and uniformity was observed, and continued tests and experiments led to the adoption of the present specifications, which have proved eminently satisfactory for all classes of concrete used by the Bureau of Bridges except concrete for piles and sheet-concrete-pavement top course. They are not ideal, nor do they include all the provisions of the standard water-cement-ratio specifications as advocated by Committee E-1 of the American Concrete Institute.

Since our concrete specification of itself is brief, I am quoting it in full: "All concrete shall be mixed in the following proportions: To each sack of 94 lb. of cement used the maximum permissible amount of water used shall be 6 gal., including all water in the aggregates. To each sack of 94 lb. of cement used the combined dry weight of fine and coarse aggregate shall not exceed 540 lb. All concrete shall be mixed for 2 min. The relative proportions of fine and coarse aggregates and water shall be determined in the field by the director so as to secure that combination of strength, workability, and density which in his judgment is most satisfactory. All cement and aggregate for concrete shall be weighed. The coarse aggregate shall be gravel, slag or stone."

All our mixes are determined by our own inspectors by the trial-batch method. When a satisfactory trial batch is obtained the inspector determines the quantities of materials required for 1 cu.yd. of concrete based upon the yield by absolute volumes, and these quantities are given to the operator of the batcher.

Trial batches are made whenever there is a change in the grading or source of supply of material. Moisture determinations are made from three to five times daily. By specifying the exact quantities of materials required to produce 1 cu.yd. of concrete we have saved a great deal of dispute between ourselves and the contractors as the amount of concrete furnished invariably checks the measurements in place within 1 per cent. and usually within one-half of 1 per cent.

For centrally-mixed concrete the concrete test-cylinders are made and cured by the plant inspector, for truck-mixer operations by the job inspector. We require 8 cylinders per 100 cu.yd. of concrete, and a minimum of 6 cylinders per hr. The concrete test-cylinders are broken in the laboratory of the Bureau of Tests under the supervision of our plant inspector, who makes notes of the type of break and condition of the cylinders as well as the strength per square inch.

On the eleven contracts that have used 8,644 cu.yd. of pre-mixed concrete since the introduction of our present 3,000-lb. specifications 348 28-day test-cylinders show an average strength of 3,300 lb. per sq. in., with 28 per cent. within 20 per cent. of the average strength. This can be compared with fifteen contracts that have used 15,381 cu.yd. of job-mixed concrete on which 632 28-day cylinders gave an average strength of 3,297 lb. per sq. in. with 81 per cent. of the cylinders within 20 per cent. of the average strength.

With the type of inspection developed by the Bureau of Bridges and Structures pre-mixed concrete has many advantages over job-mixed concrete which more than offset its disadvantages:

1. In the Pittsburgh plants all cement and aggregates are weighed. When concrete is mixed on the job it is difficult to get the contractor to weigh the cement.

2. The amount of water can be measured much more accurately than is possible with most of the water-tanks that are on job mixers.

3. The moisture content of the aggregates is more constant. When aggregates are batched at a central plant and hauled in open trucks to the job, the moisture content is at the mercy of the weather, and I have known as much as 700 per cent. variation in the moisture content of two consecutive loads.

4. The mixers are of large capacity, thus lessening the batch-to-batch variations. It is manifestly easier to get 50 3-cu.yd. batches alike than it is to get 300 ½-cu.yd. batches alike.

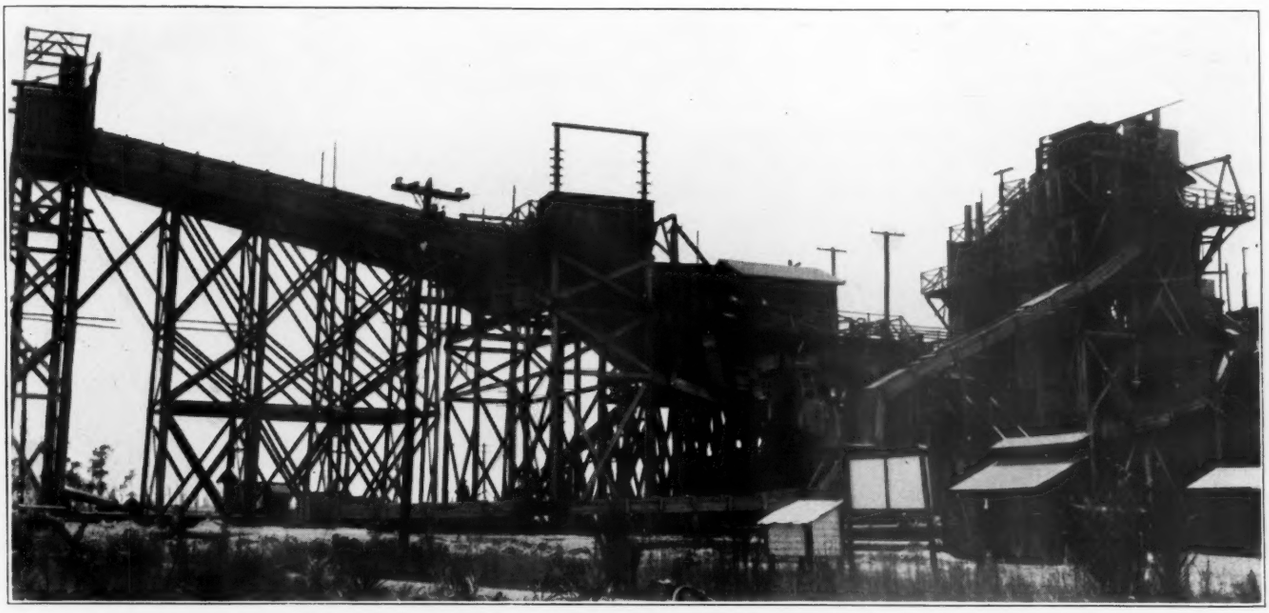
5. The batching and mixing are done by experienced men, whose sole occupation throughout the year is the making of concrete, a decided contrast to the usual job conditions where the nearest handy man is grabbed by the superintendent to run the mixer.

6. Lastly, the companies who manufacture and sell pre-mixed concrete are vitally interested in good concrete and, therefore, all the persons connected with the company are interested in establishing a reputation for dispensing a product that will be eminently satisfactory to both the owner's architect or engineer and to the contractor.

On the other hand, pre-mixed concrete has decided disadvantages which, while they can be easily avoided, can cause much trouble if the manufacturer is careless and if the contractor is not familiar with pre-mixed operations:

1. Concrete is a substance which of its very nature must be placed in its final position within a

(Continued on page 54)



Plant for processing pebble phosphate. Gathering box and flat screens at the right.

Washing and Drying Methods Employed in Florida Phosphate Operations

By J. R. CUDWORTH
School of Mines, University of Alabama

IN the removal of overburden and the hydraulicking of the phosphate rock considerable disintegration of the phosphate matrix occurs. The pulp of matrix and water reaches the washer by centrifugal sand pumps through 8-in. to 12-in. cast-iron pipes. On this journey still more disintegration takes place.

The washing operations are comparatively simple, consisting mainly of disintegrating, dewatering, and screening steps. The ore, which is composed of phosphate pebbles of varying size embedded in a matrix of clay and loose or loosely-cemented sands, presents little difficulty in washing when the phosphate pebbles are coarser than 14-mesh in size. Below this size, however, the washing is more difficult. Up to three years ago, little or no attempt was made to save the finer sizes, which contain certain fractions (14-mesh to 20-mesh in size) that are commercial in analysis but which require screening for separation from the finer sands that are not merchantable. This washing practice has resulted in the accumulation of many large *débris* banks containing material which will undoubtedly be reworked if a suitable process can be developed. The phosphate rock recovered in the ordinary washing operations represents about 50 to 60 per cent. of the total phosphatic content of the matrix.

The land-pebble phosphate washers operate on a larger scale than those in the hard-rock district. They are of wooden or steel construction and are not housed as in the other field. Many of the latest washers are of steel construction, which gives a longer life and less depreciation, although a higher initial cost. These are erected where there is sufficient phosphate rock available within working distance to warrant the additional cost. The capacity of the land-pebble washers varies from 25 to 100 tons of finished product per hour. The variation in the quality of the ore and the hydraulic method of mining, with its surges in feed, affects the capacity to a marked degree, often causing the washers to be overloaded. The electric power for the washers either is generated by the companies themselves or is purchased from public-utility companies, although, at present, the trend is in the last-mentioned direction.

Most of the washers in the land-pebble district have similar flow-sheets, differing for the most part only in the makes of equipment and in the reclaiming units for the finer sizes of phosphate rock.

The customary practice in the district is to use stationary flat screens for removing the water and fine sand at the head end of the washer. These are followed by single-jacketed trommels for removing the coarse *débris* including trash, clay balls and pieces of limestone. For further disintegrating the ore, log-washers, cylindrical mills, and other devices are used; these are followed by vibrating screens or trommels for further sizing and screening.

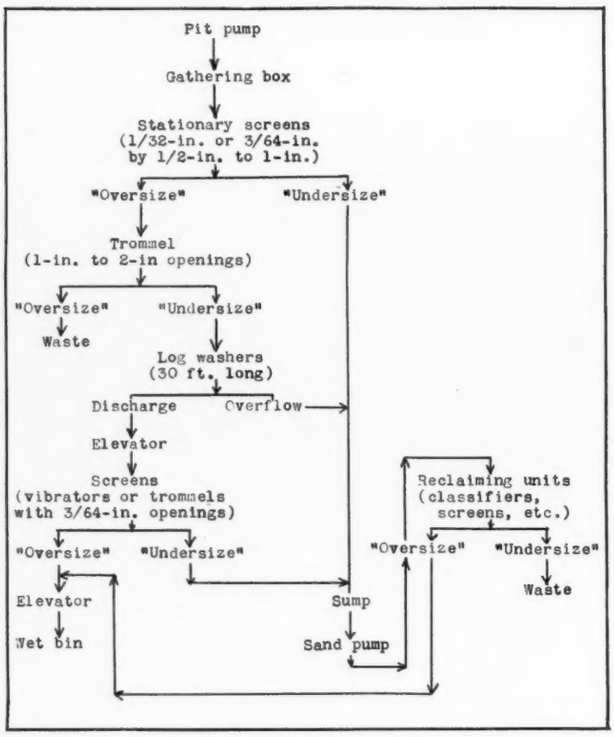
In the washing plants of the district the equipment used varies according to the experience of the

several operators. Of the vibrating screens now on the market those furnished by the Link-Belt Co., the C. W. Hunt Co. (Mitchell); the W. S. Tyler Co. (Hum-mer); the Traylor Vibrator Co.; and Universal Vibrating Screen Co., are in operation in several plants. For pumping pulps containing sand and matrix, sand pumps manufactured by the Georgia Iron Works, Augusta, Ga., are largely employed. For high-pressure water service, the Hydrocone pump of the Allis-Chalmers Mfg. Co. has recently been introduced into the district; as have also pumps manufactured by other companies.

The log-washers in the district largely follow the design of the Georgia Iron Works washers, but many are constructed by the individual companies. In supplementing the disintegrating action of log-washers, one company uses conical ball-mill shells, such as those of the Hardinge Co., without grinding media, but equipped with lifter bars and flights. Mechanical classifiers of the Dorr bowl type, have a place in the flow-sheet of several plants.

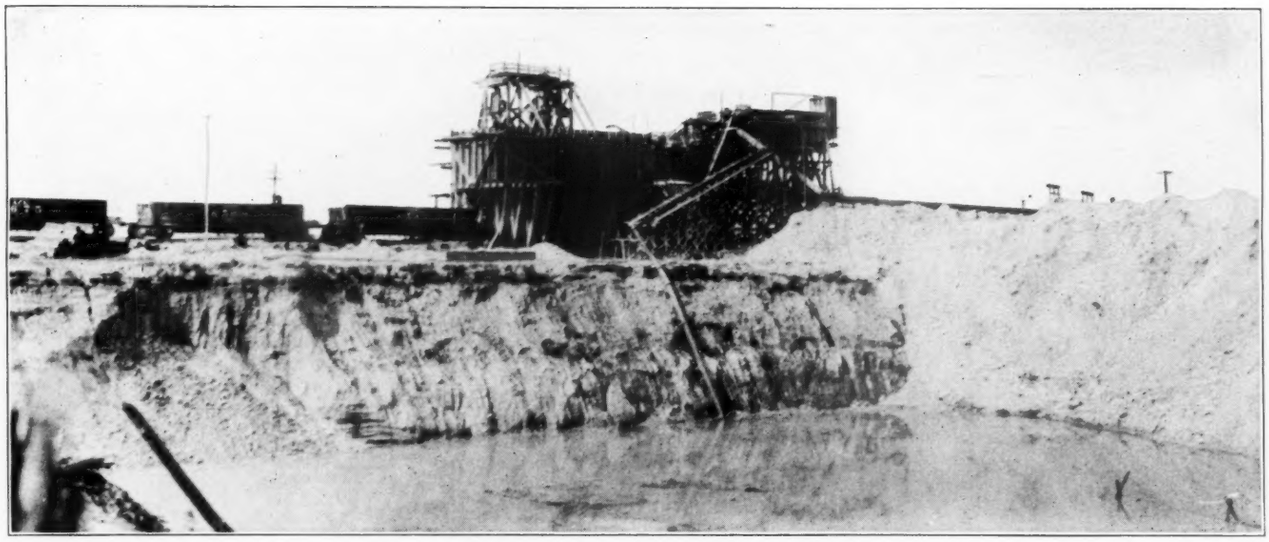
Recently an increased interest in obtaining a higher recovery of the phosphate from the matrix has been evident. Several companies have been increasing their washer recoveries by saving finer sizes (14-mesh to 20-mesh) that were formerly discarded. This material usually analyzes higher than the minimum grade of commercial phosphate rock. These increased savings have been effected by various methods. In some plants the desired results have been obtained by a rearrangement of the washer flow-sheet and the use of screens with smaller openings but, in others, auxiliary units, including hydraulic and mechanical classifiers and additional screens, have been installed.

For the treatment of fine phosphatic sands that are low-grade, one company has introduced flotation. Other companies are actively carrying on research with processes based on mechanical separations between the phosphate and sand grains, or upon chemical or pyrolytic methods for extracting the phosphoric acid. The United States Bureau of Mines, at its Southern Experiment Station in coöperation with the University of Alabama, has been studying the problem of obtaining increased recoveries of phosphate from the treatment of the deposits in the Florida land-pebble district.



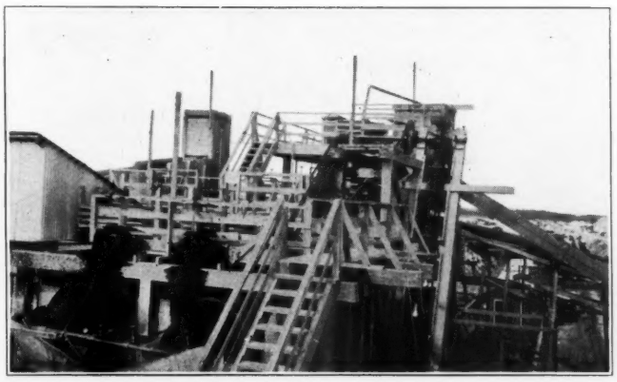
Flow-sheet of a typical phosphate operation.

A drying plant with huge storage piles at the right.



A washing plant for land-pebble phosphate with pit in foreground.

The washed pebble-phosphate rock is hauled to the drying plants of the various companies in bottom-dump steel and wooden cars over standard-gauge railroads which, in some cases, have been electrified. At the drying plants the wet rock is dumped into storage bins of large capacity, and the various grades of rock are kept separate. Since



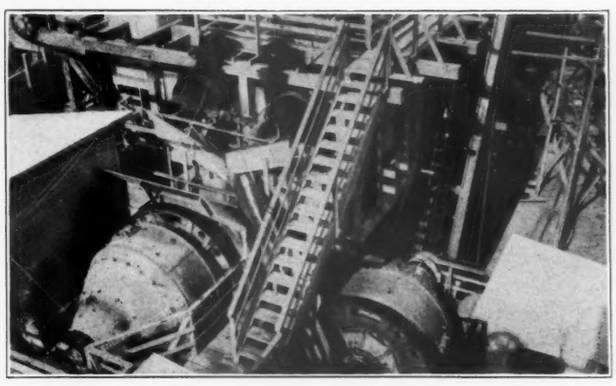
A phosphate-washing plant showing the jacketed revolving screens.

market demand fluctuates, large storage piles of wet rock are maintained by all companies to keep their productions on uniform and fairly even scales. From the wet-ore bin, constructed of wood and concrete, the rock is fed by belt-conveyors to rotary driers largely of local construction. In these driers, which are heated by oil-burners, the moisture content of the phosphate rock is reduced from between 10 and 16 per cent. to 2 per cent. or less. The dry rock is then conveyed by belts and elevators to dry-storage bins and loaded into railroad cars. These large drying plants and storage bins of concrete-and-steel construction are impressive sights in the district. The railroad cars for shipping the dry phosphate rock to the loading terminals at Tampa or Boca Grande are specially designed with close-fitting steel covers for keeping the rock dry and with bottom dumps for unloading at the docks.

Low-grade phosphate rock containing from 66 to 68 per cent. bone phosphate of lime (B. P. L.) is largely sold for domestic consumption, while a considerable portion of the higher-grade rock, particularly the grade containing 75 to 77 per cent. bone phosphate of lime, is exported, mainly to European markets.

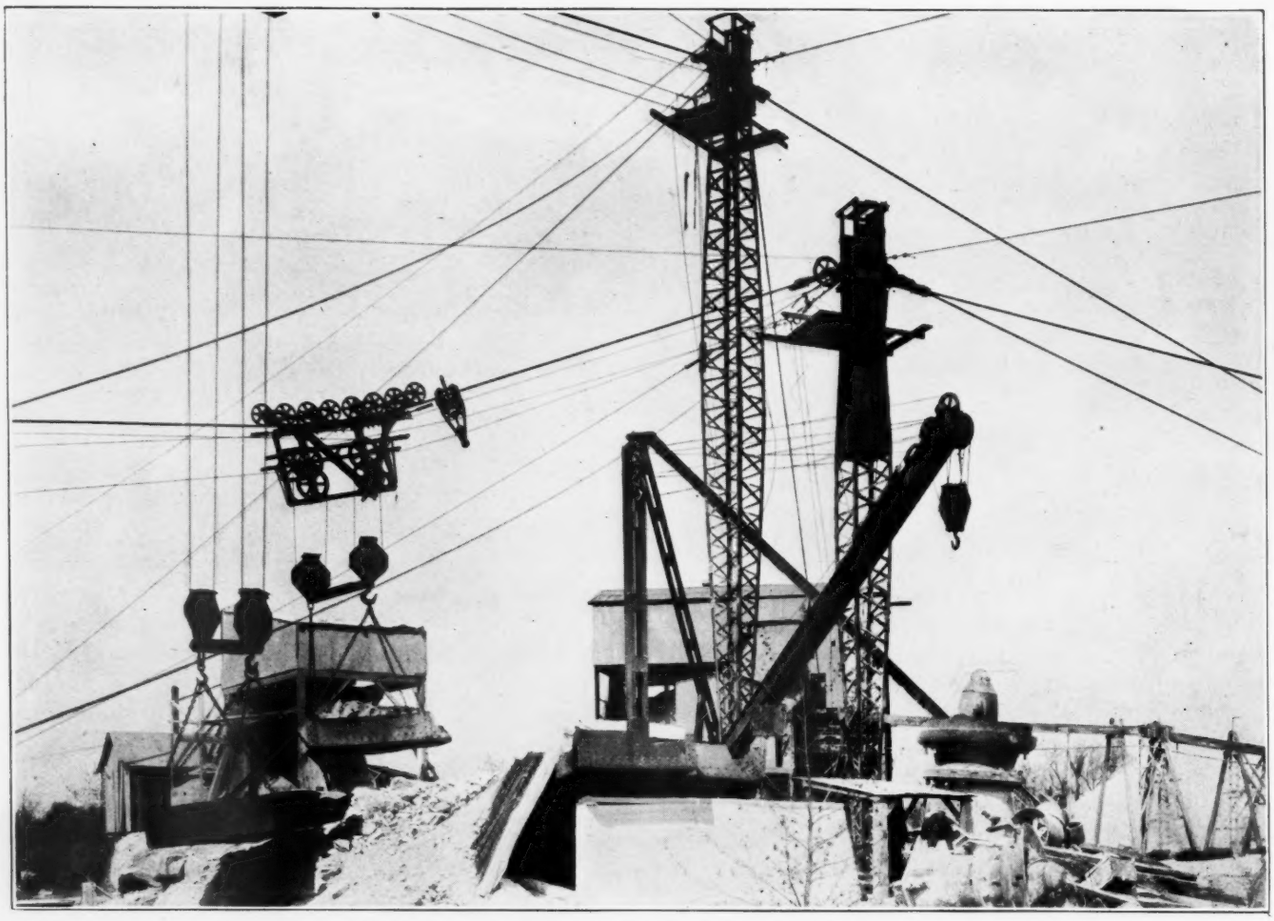
Of the tonnage of pebble-phosphate rock sold for domestic consumption, the largest use is for the production of fertilizers. The second largest use is the manufacture of phosphorus and chemicals containing phosphorus. In 1927 none of the companies in the Florida land-pebble district reported the sale of raw phosphate rock ground for direct application to the soil as fertilizer.

Each company maintains an up-to-date village, in which the drying plants, machine shops, and general offices are located. Modern commissaries, employees' houses for both white and colored workers,



View of the washers, showing the conical ball-mills.

staff houses for the unmarried employees, and schools are maintained. Recreation facilities, including swimming pools and parks, have been built by some of the companies. These have also been active in promoting safety measures for their men, including first-aid training.



Cableway towers where the stone is dumped to the crushers.

Traveling Cableway Anchor Employed at Southern Crushed-Stone Plant

High-Speed Gyratory Crushers Another Feature of Operation in South Carolina

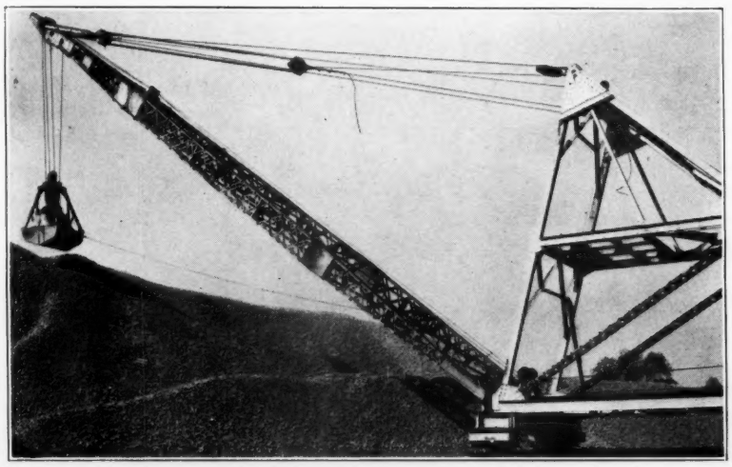
AN inspection of the Cayce, S. C., plant of the Weston & Brooker Co. is indeed a privilege, for in this, the home plant of the company, one sees some of the most unique engineering developments in the industry. Not only a large plant, the Cayce operation is a progressive one, and its methods of operation are exemplary of deep-quarry stone production. Its daily output is in excess of 1,500 tons.

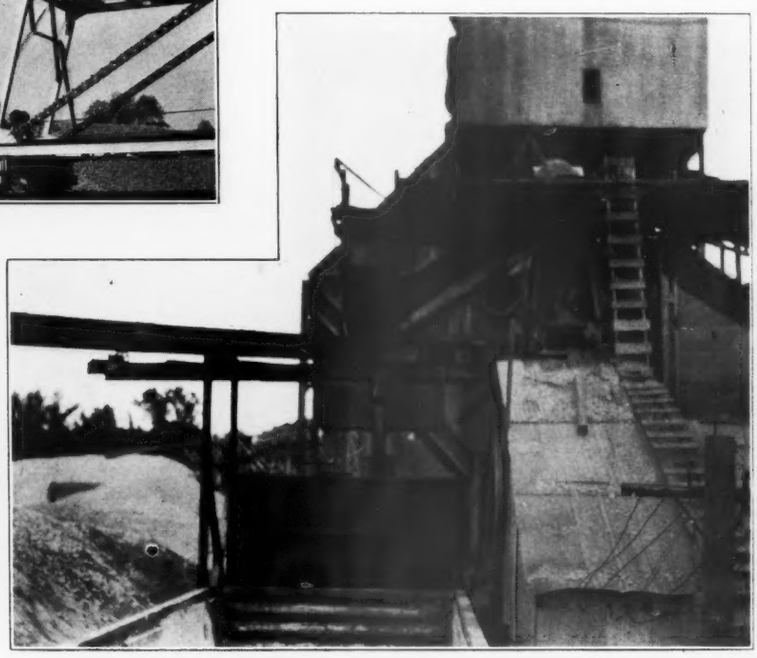
To W. S. Weston, vice-president and chief engineer of the company, goes the credit for the conception and design of the many unique mechanical devices in and about the plant. Some of these include high-speed gyratory crushers claimed to be the first of this type, a traveling taut-line cableway tail-anchor, a stock-pile crane, and many others, all which will be described in their proper sequence in the plant flow-sheet.

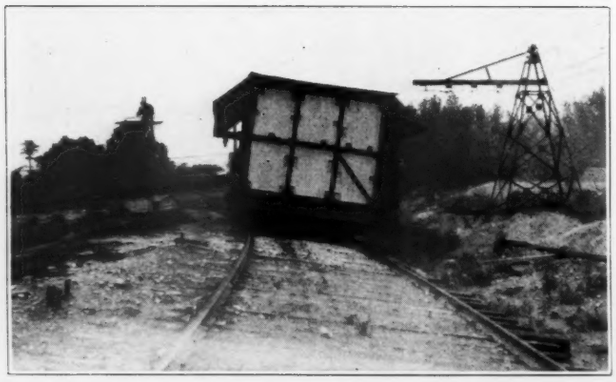
The company's quarry is a hard, gray granite deposit, is roughly rectangular in shape, being approximately 800 ft. long and 700 ft. wide. After nearly 40 yr. of continuous operation the quarry is now approximately 185 ft. deep. Drilling and blasting operations are at present confined to the north face, although some work is occasionally done on the south face. Work on the north face progresses in two ledges, one being 85 ft. high and the other 100 ft. high. The method of drilling follows standard quarry practice, 6-in. blast holes being drilled on 12-ft. by 25-ft. centers by 4 Keystone well-drill rigs. The holes are loaded with 75-per cent. dynamite in the bottoms and 60-per cent. dynamite in the tops. Burton 4½-in. by 16-in. cartridges are employed as the blasting agent. A normal yield of 4 tons of granite per pound of explosive is obtained.

In recovering the blasted rock, two taut-line skip-cableways are employed, the skips being loaded by two power-shovels on the quarry floor. The two cableways span the quarry, the head masts being near each other and in a fixed position, so their skips discharge directly over the primary jaw

Above—Airplane view of the plant and part of the quarry of Weston & Brooker Co. at Cayce, S. C. *Below*—Revolving clam-shell used for handling material at stock-pile. *In circle*—Sump cave on quarry floor for collecting seepage water. *Lower Left*—Shovel loading stone to pans for elevation to the crusher. *Lower Right*—The automatic spreader used in loading cars.







The tail-anchor car permitting movement of the cableway was designed by W. S. Weston.

crusher. The tail masts are movable, No. 1 unit having a track back of the west face and the No. 2 unit having a track located back of the north face. The two traveling tail masts allow a wide latitude

Revolving screen for washing and classifying.

of operation; in fact, any part of the quarry floor can be conveniently reached. Both units are capable of handling heavy loads; often heavy machinery is handled, while 5 tons of rock is normally carried in the skip pans.

The No. 2 unit frequently shifts the drill rigs to

The diamond-shaped steel loading bins.

and from the ledges; both shovels were lowered to the quarry floor. To do this, the larger shovel was partially dismantled, then lowered in sections and later reassembled.

The No. 1 cableway has an 850-ft. span; its tail mast is somewhat similar to the type commonly

Well drills working on the north ledge in the quarry.

used in logging operations. Power machinery in the tail-mast car includes a 4-drum hoist for the working ropes beside separate propulsion machinery. The skip is operated at 225 ft. per min. when hoisting, and 720 ft. per min. when conveying. Both cableways employ Hercules Red Strand 2¼-in. wire rope for the main spans; the working lines are Broderick & Bascom Yellow Strand ¾-in. wire rope.

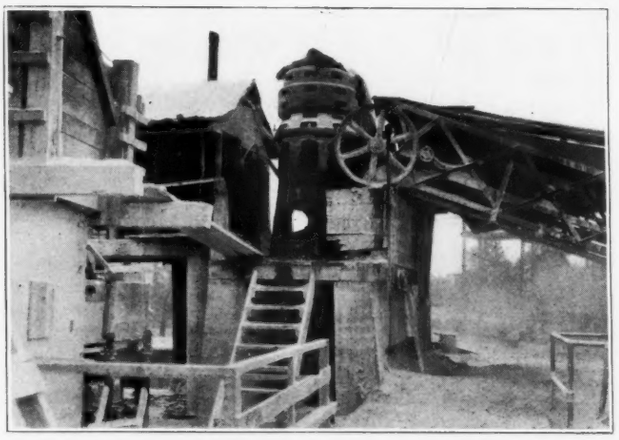
The No. 2 cableway is of special interest, in that the tail mast is in reality not a mast but a traveling

Tail mast of the No. 2 cableway.

car—one of Mr. Weston's most interesting engineering works. The car carries the hoisting machinery as well as its own propulsion motor and is banked at an angle of 15 deg. to the horizontal plane. The track upon which it travels is built in an arc of a circle on a fill extending along the top of the north quarry section so that the back cable and working ropes have sufficient clearance over the brink of the quarry ledge. The track has a 14-ft. gauge and is guarded with extra rails. An almost solid roadbed of ties insures firm footage. The mechanical equipment in the traveling car consists

of an electric-motor-driven 4-drum hoist, two drums of which operate the conveying ropes, one drum manipulating the hoisting rope and the fourth drum the dumping rope. This cableway system has a higher conveying speed, 900 ft. per min., than the No. 1 unit, but a lower hoisting speed, 175 ft. per min., which is accounted for by the fact that it is designed to handle heavier loads.

The skip-pan carriages of both cableways are specially designed to prevent the kinking of the track cables when heavy loads are handled. Each carriage, through 4 pairs of track wheels, carries its load evenly over a considerable distance of the



High-speed crusher designed by Mr. Weston.

cable. The wheels, which are mounted in pairs, adjust themselves to the catenary curve of the cable. A platform on the carriage allows a workman to make a daily inspection of the track cable.

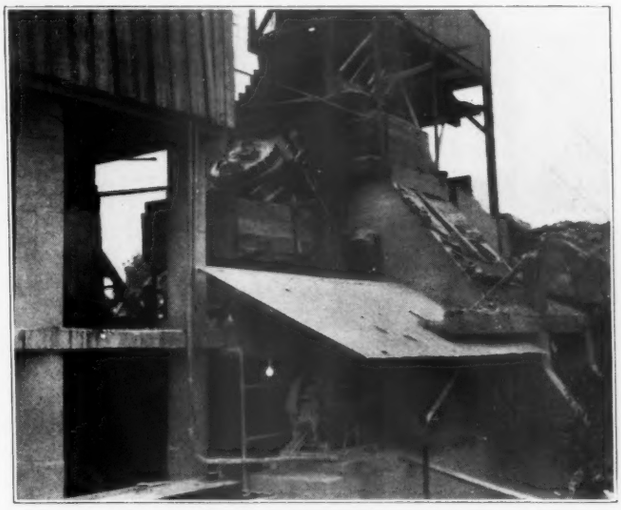
Mechanical loading of the skip-pans by power-shovels replaced hand loading some years ago. For this work two shovels are employed, one a Bucyrus 50 B, 2-cu. yd. unit and a Marion 32, 1½-cu. yd. machine.

Pans of rock are brought by the cableways direct to the No. 27 Kennedy gyratory crusher for primary reduction. This machine is belt-driven by a 200-hp. G. E. motor. The crushed rock, minus

The scalping screen and crushers at right.

Looking into the quarry with plant in the distance.

4-in., is received by a 42-in. bucket-elevator, 45 ft. long on centers, and delivered to an 8-ft. by 12-ft. grizzly screen which has 2½-in. free openings. Oversize "rejects" from this screen pass under a Cutler-Hammer power magnet which removes tramp iron, and goes thence to a Symons 5½-ft. cone crusher for secondary reduction to 2½ in. The product of this machine is sent to a 12-ft. revolv-



A magnet suspended over the feed to the secondary crusher picks out any tramp iron.

ing scalping-screen for the separation of plus-2½-in. stone which is sent by a 20-in. belt-conveyor to a Weston crusher. The latter's product is returned to the scalping-screen, the crusher being in a closed-circuit with the screen.

The Weston crusher is claimed to be the first high-speed type gyratory crusher with an inbuilt vertical motor. It was designed specifically for high-capacity secondary crushing and is considered by many as the forerunner of similar machines now on the market.

From the scalping-screen a 24-in. belt-conveyor, 180 ft. long on centers and carried on a steel frame incline, delivers the crushed granite to the screening-and-loading building. The latter is a 4-compartment steel structure, 41 ft. wide by 59 ft. long, the end section of which is diamond-shaped. The

tops of the compartments are open, allowing the stocked material to be removed from the compartments by a crane for open-pile storage. The crushed material is received from the inclined conveyor in a flume, where a heavy stream of water is added to assist the flow into a 60-in. by 20-ft. revolving screen. The latter unit, with five 4-ft. screen panels, screening sizes ranging from 7/8-in. to 1 3/8-in., with a 7/16-in. jacket, classifies the stone into the principal commercial sizes. The minus-

Skip pan dumping to primary crusher.

7/16-in. stone from the jacket is given further separation by means of two vibrating screens, both designed by Mr. Weston.

Directly beneath the bin a 30-in. loading belt receives any size or proportion of sizes of granite from the bins and delivers them to the loading platform. Here Mr. Weston designed and built an automatically-operated spreader. Operated by a small air hoist, it delivers the aggregate products to the cars in evenly spread piles without segregation.

Circular stock-piles of crushed granite enable an enormous amount of this material to be stored. Another one of Mr. Weston's interesting works, the stock-pile crane, affords an excellent medium for the removal of excess material in the bins to storage and the subsequent recovery of it. The crane is pivoted, the boom supports being a circular track of 90-ft. diameter. The 90-ft. boom allows an operating range 135 ft. in diameter. The crane is equipped with a 2½-cu. yd. Hayward bucket operated by means of a Lambert 4-drum hoist. Three distinct circular, concentric piles are maintained, storing up to 35,000 tons.

The Weston & Brooker organization.

Pre-Mixed Concrete's Possibilities

(*Continued from page 46*)

comparatively short time from the time of its manufacture. This means that more careful scheduling of construction operations is necessary than is the case with other building materials or with job-mixed concrete.

2. It is necessary to estimate accurately, and some time in advance, the amount of concrete required for a pour so that the manufacturer can adjust his plant and truck operations.

3. A workable, rapid, and complete system of coördination between the plant and the job is essential.

4. The most serious difficulty is that changes in the consistency of the concrete, due to variations in the aggregate grading and moisture content, can not be detected until the job is reached, by which time several more truck-loads of unsatisfactory concrete are on the way.

Pre-mixed concrete has a wonderful future before it. As the congestion of building operations in cities increases, with the consequent lack of space for job equipment, more and more contractors will turn to purchasing their concrete as they now purchase their bricks or steel. It has been suggested that a logical development would be the placing of the concrete by the pre-mixed companies. I am sure that this development will come very soon.

Within the last two months a general contractor in Pittsburgh endeavored to get some firm to mix and place the concrete on a bridge-repair job. Unfortunately, a satisfactory price could not be agreed upon, and the idea did not materialize, but in the near future the same contractor has several hundred cubic yards of concrete to pour on the deck of a viaduct, and he has assured me that he will try to get bids for the concrete furnished and placed.

Manufacturers of pre-mixed concrete must establish a reputation for making a product of above-average quality, and they can do this by obtaining high-grade cements of established reputation, by insisting that the aggregate they use are clean, well-graded and in conformity with the most rigid specifications, by mixing not less than 1½ min., which will give better consistency and more uniformity in tests than a shorter mixing time, and by establishing a plant technique which is in accord with the highest and best standards of concrete production.

The Commercial Utilization of Dolomite and High-Magnesium Limestone*

By PAUL HATMAKER
Mining Engineer, Building Materials Section,
United States Bureau of Mines

LIMESTONE, geologically, is a rock composed essentially of calcium carbonate; commercially, however, the term may include dolomite and magnesium limestone.

Dolomite is a distinct mineral composed of calcium and magnesium carbonates combined in molecular proportions as expressed by the formula $CaMg(CO_3)_2$. Dolomitic limestones are those which, though containing considerable dolomite, include in addition either calcium carbonate or a physical mixture (not a chemical combination) of calcium and magnesium carbonates. Ordinarily the term *limestone* means a rock containing less than 10 per cent. of magnesium carbonate. With more than 10 per cent. of magnesium carbonate the term *magnesium limestone* is used until the amount is about 40 to 45 per cent., when such rock is called *dolomite*. The term *high-calcium limestone* commonly means one containing at least 95 per cent. of calcium carbonate and not more than 5 per cent. of magnesium carbonate. *Low-magnesium limestone* applies in a general way to rocks in which the magnesium-carbonate content is between 10 and 20 per cent.; with more than 20 per cent. magnesium carbonate the term *high-magnesium limestone* may be employed. Many rocks containing a high percentage of magnesium carbonate are not true dolomites, but dolomitic or high-magnesium limestones. They are, however, commonly known as *dolomite*. No very definite lines of demarcation have been fixed to designate the various gradations from high-calcium limestone to pure dolomite.

Dolomite, at best, is a low-priced commodity. Extensive deposits are found in many localities, but for many of its uses it must compete with limestone, which is even more abundant and widely distributed. For some purposes it is even less desirable than limestone, and for those purposes for which its magnesium content is important it meets competition from other sources of magnesium, notably magnesite and natural magnesium salts and bitterns. Even sea water contains magnesium which is occasionally extracted therefrom, but frequently the liquors which remain after common salt (sodium chloride) has been extracted are allowed to go to waste, although they may contain considerable magnesium. In localities remote from manufacturing activity, dolomite deposits must be recognized as having little present commercial value and, even in the industrial areas, there is nothing that approaches an open market. Consumers, as a rule, either own quarries or have necessarily established contractual relations which guarantee their supplies.

Quarry operations are begun for a variety of reasons and the control of a favorable quarry site is one and often only a minor factor in the successful establishment of a new enterprise. Before undertaking the working of a dolomite or magnesium limestone deposit the prospective operator should give particular thought to all the economic factors involved, among which may be mentioned (1) Markets and market demands, (2) adequate supply and uniformity of raw material, (3) capital requirements, including working capital after the producing stage has been reached, (4) production costs, and (5) possible competition.

Origin and Occurrence.—The genesis of dolomites is not thoroughly understood. Some are thought to be of marine origin, formed either directly from magnesium and calcium salts in the sea water, or by a subsequent magnesium enrichment of calcium carbonate already deposited from the ocean by organisms.

Some magnesium limestones and dolomites, however, are of other than marine origin. In certain localities, beds of calcium limestone alternate with strata of limestone containing a greater or lesser percentage of magnesium carbonate. Analyses of a single limestone bed, too, may vary over a relatively small area. The formation of such deposits would indicate that the magnesium carbonate is concentrated either by the leaching away of the more easily dissolved calcium carbonate or by a direct deposition of magnesium carbonate from circulating ground waters; in fact, both processes doubtless have effected changes in some instances.

The consensus of opinion seems to be that most dolomites and magnesium limestones were not orig-

ANOTHER use for limestone which may create a huge demand in the future is being carried in current news dispatches in the announcement by E. I. du Pont de Nemours & Co., of its development of synthetic rubber, the primary raw material being acetylene which requires coal and limestone in its production. The company is already constructing a plant in New Jersey for its manufacture on a commercial scale. The product has been named "Duprene" and is said to be superior to natural rubber in many respects. Its use is not expected to displace the natural product in the manufacture of tires, at least not for some time but, in the event of national emergency, it could be satisfactorily substituted, Du Pont officials believe.

* Reprinted from U. S. Bureau of Mines Information Circular 6,524.

inally deposited as such, but that dolomitization resulted from changes subsequent to deposition, mainly by the action of magnesium salts in sea water.

Dolomite and magnesium limestones are widely distributed over the world. In some localities deposits attain enormous proportions, as in the Dolomite Alps of Europe. Many occurrences are associated with calcium limestones, but only few with magnesite. Deposits may be evenly-bedded or may be greatly deformed and some have become metamorphosed to dolomitic marbles. Examples of this type are found in Vermont, Massachusetts, New York, Georgia, and Tennessee. Because of the wide distribution of dolomite and magnesium limestone in the United States no attempt can be made here to list such occurrences.

Production Methods.—The mining or quarrying of dolomite does not differ essentially from that of limestone, and the methods employed for preparing it for market are likewise the same as for limestone and need not be described. In calcining, however, the presence of magnesium carbonate introduces some special problems. The best grade of lime is produced when the temperature is held as closely as possible to the point where the carbon dioxide is given off freely. For pure limestone this reaction begins at about 900 deg. C. and the heat may be safely carried to 1,200 deg. C. Overburning is caused by too high a temperature and the resulting product may be dense and discolored, and much more difficult or even impossible to slake. Since the decomposition temperature of magnesium carbonate is about 750 deg. C. and that for dolomite about 850 deg. C., it follows that temperatures which may be safe for burning a high-calcium limestone may overburn the magnesium carbonate and, conversely, temperatures sufficient to calcine the magnesium carbonate or dolomite may leave the calcium carbonate in the raw state.

Market Prices.—The ultimate value of dolomite and magnesium limestones depends mainly upon the extent of preparation for market. Because limestone is widely distributed and is very abundant, it commands a relatively-low price, but quarrying, crushing, sizing, burning, and hydrating add proportionately to the cost of the finished product. The market value of such material therefore depends mainly upon the expense of manufacture. Another factor influencing price is the location. Owing to natural conditions, some localities are able to produce limestone products at a lower unit cost than others. Transportation of the material is also an important factor in the ultimate value. Where limestone products must be transported any appreciable distance the freight charges in many cases are larger than the original cost of the material. Production statistics yield an approximation of the unit value of dolomite and high-magnesium lime. It will be noted that raw stone sold by producers for dead-burned dolomite in 1929 was valued at less than $1 per ton. Dead-burned material for that year had an approximate unit price of about $8.75 per ton. The dolomite sold or used by producers for manufacture of basic magnesium carbonate had a unit value in 1929 of about $1.50 per ton.

High-magnesium lime sold for use in sulphite paper mills in 1929 had a unit va'ue of about $7.80. It must be understood that these prices are very general and do not apply to any one particular operation or locality but are the average of all stone reported to the bureau for the uses described.

Description

Dolomite occurs massive, finely or coarsely granular, or crystallized in small rhombohedral crystals which often have characteristically curved faces. The color varies from white to gray or brown, or, more rarely, to blue, pink, or yellow. Many magnesium limestones can be distinguished from calcium limestones only by chemical tests. Weathered dolomite is typically chalky white, but variations in magnesium content or impurities may cause differences in color and general appearance.

Composition.—The theoretical composition of pure dolomite is 54.3 per cent. calcium carbonate ($CaCO_3$), and 45.7 per cent. magnesium carbonate ($MgCO_3$). Expressed in another way, it contains lime (CaO) 30.4 per cent., magnesia (MgO) 21.8 per cent., and carbon dioxide (CO_2) 47.8 per cent.

Magnesium limestones may vary in composition from practically pure $CaCO_3$ with only a small percentage of $MgCO_3$ to a dolomite. Very rarely the percentage of magnesium carbonate is greater than that of a dolomite and may grade to magnesite which, theoretically, is pure $MgCO_3$.

Properties.—Dolomite (hardness 3.5 to 4) is slightly harder than calcite but generally softer than fluorite. The specific gravity is 2.8 to 2.9, therefore it is slightly heavier than calcite (specific gravity 2.72). Pure dolomite does not melt; application of sufficient heat drives off carbon dioxide, leaving calcium and magnesium oxides. The temperature of this dissociation is about 850 deg. C., or 1,562 deg. F. Crystals of dolomite are pearly or vitreous. If granular, however, the luster is dull or earthy. Dolomite crystals are brittle and break with an uneven to conchoidal fracture. Fragments transmit light poorly or not at all. Certain physical properties, such as porosity and crushing strength, vary among different deposits.

High-calcium limestones effervesce freely in cold dilute hydrochloric acid, but dolomite and high-magnesium limestones effervesce only if the acid is heated. If polished portions of magnesium limestone are etched by cold, weak acid and then examined under a microscope the true dolomite will be found unaltered, but the separate calcium carbonate will show surface effects of solution.

Uses of Limestone

Those uses which to a varying degree are dependent upon or affected by the chemical composition of the stone are in (1) refractories, (2) "technical carbonate," (3) certain processes of paper manufacture, (4) some types of lime mortars, (5) blast-furnace flux, (6) Vienna lime, (7) glass works, (8) carbon dioxide and chemicals, (9) agriculture, (10) paints, kalsomine, whitewash, and var-

nish, (11) ceramics, (12) prepared whiting, (13) rubber preparations, (14) tanneries, (15) fungicides, and (16) such miscellaneous uses as in pig-iron casting, in "pickling" iron and steel, in wire drawing, and in the manufacture of strawboard.

Dolomite, like limestone, may be used as building stone, and as crushed stone, both which uses, of course, are contingent mainly upon physical properties.

Uses Depending on Chemical Properties

Refractories.—Dolomite and high-magnesium limestone are used extensively as substitutes for magnesite refractories in basic open-hearth steel furnaces and basic Bessemer converters; in lead-refining reverberatory furnaces, lead cupelling furnaces, and crucibles for lead blast furnaces; in copper converters and copper reverberatory furnaces; and in the form of crucibles for melting metals. Dead-burned material in various forms is commonly used, although raw dolomite may be employed for minor repair work.

Dead-burned dolomite is made by calcining dolomite or high-magnesium limestone to about 1,500 deg. C. either in a blast-furnace or in a special kiln. At this temperature virtually all the CO_2 is driven off, leaving CaO and MgO, which sinter to an extent depending upon the impurities present. Many manufacturers add certain agents such as iron oxide, alumina, and silica to the crushed dolomite before calcining, which aids the sintering action. In one process these agents are ground with the dolomite in a wet mill. The slurry is subsequently calcined and clinkered in a rotary kiln similar to that used in the manufacture of cement.

Recently some dolomite deposits, which contain the necessary impurities in the right proportion, have been found in Missouri. The use of this stone, dry-crushed to granular size and dead-burned, has resulted in a production of a high-grade material, said to be superior to the synthetic mix.

There are two general ways of utilizing dolomite as refractory-masonry work: First, burned dolomite is mixed with tar or a fluxing agent and is applied as a monolithic lining; second, burned dolomite, to which is added tar or suitable fluxing agents, is formed into brick shapes, which are fired and then laid in the same manner as other refractory brick.

In steel furnaces the sides and top are usually made of silica brick. Two or three courses of fire brick are laid in the bottom upon the steel shell. There are then added two or more courses of magnesite brick which are stepped up at the sides. The basic bottom is spread directly on the magnesite brick. This material usually is dead-burned grain magnesite, sometimes mixed with hot tar or molasses. A binder of 5 to 20 per cent. of basic-cinder slag is added. The grain magnesite is fused on in successive layers, building up the front and back walls well above the slag line.

Where dead-burned dolomite is used as a substitute for magnesite in such basic bottoms, the raw stone should contain less than 1 per cent. of SiO_2, less than 1.5 per cent. of combined Al_2O_3 and Fe_2O_3, and at least 35 per cent. of $MgCO_3$, the rest being calcium carbonate ($CaCO_3$). Dolomite is somewhat inferior to grain magnesite for this purpose; however, raw or calcined dolomite is satisfactory for minor repair work which requires 40 to 50 lb. or more per ton of steel.

Table I, compiled by the Bureau of Mines, indicates the extent of the dead-burned dolomite industry.

TABLE I.—DEAD-BURNED DOLOMITE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, 1920-1929

Year	Reported as Raw Stone (*short tons*)	Reported as Dead-Burned (*short tons*)	Total Quantity Calculated as Dead-Burned (*short tons*)
1920	612,800	316,293	623,000
1921	79,480	107,664	147,000
1922	146,640	348,838	422,200
1923	205,890	357,642	460,600
1924	309,010	328,659	483,200
1925	415,710	392,145	600,000
1926	511,300	386,715	642,000
1927	434,160	374,415	591,000
1928	522,850	448,761	710,000
1929	516,400	488,032	746,000

Technical Carbonate.—Technical carbonate finds its widest utilization in the manufacture of pipe and boiler covering, and for general heat insulation, but it is also used in pharmacy, in the rubber trade, as an accelerator, and as a constituent of certain paints, varnishes, glass, printing inks, cosmetics, table salt, tooth-paste, and other commodities. Other names for this material are *basic magnesium carbonate, block magnesia,* and *magnesia alba.* Both in England and in the eastern United States technical carbonate is made chiefly from dolomite by the Pattinson process or a modification thereof, in which dolomite mixed with coke is first calcined, thus driving off the carbon dioxide, which is recovered, purified, compressed, and cooled. The calcined rock, essentially a mixture of CaO and MgO, is slaked in water and then recarbonated with the recovered CO_2. In this operation there is made an insoluble calcium carbonate and a soluble bicarbonate of magnesia ($Mg(HCO_3)_2.H_2O$). The calcium carbonate is removed by filtration and the filtrate is boiled, which drives off some of the carbon dioxide and precipitates a white basic magnesium carbonate somewhat variable in composition but considered as having the formula $4MgCO_3, Mg(OH)_2.5H_2O$.

For the manufacture of the so-called "85-per cent. magnesia" molded insulation, technical carbonate is mixed with asbestos fiber and perhaps other bonding agents, molded into the desired form, dried for 5 or 6 days, and finally cut to true dimension with special machinery.

Table II shows the amount of dolomite used in the manufacture of technical carbonate.

TABLE II.—DOLOMITE SOLD OR USED BY PRODUCERS IN THE UNITED STATES FOR MANUFACTURE OF BASIC MAGNESIUM CARBONATE, 1920-1929

Year	Short Tons	Value
1920	57,300	$107,107
1921	32,050	60,648
1922	53,170	79,313
1923	116,410	146,337
1924	98,160	129,390
1925	98,980	131,440
1926	72,850	110,560
1927	69,940	115,932
1928	94,200	122,260
1929	84,750	129,383

Paper Mills.—One of the most important methods of making paper from wood is the sulphite process, which is used mainly for the wood of coniferous trees, such as pine, spruce, and hemlock. By digestion in an acid liquor under high temperature and pressure, all the constituents of the wood chips except cellulose are dissolved and removed. This acid liquor is a solution of magnesium and calcium bisulphites, together with more or less free sulphur dioxide, and is obtained by treating either milk of lime or wet limestone with sulphur dioxide, prepared by burning sulphur or iron pyrites in air.

Dolomitic or high-magnesium lime is preferred for preparing the acid liquor from milk of lime. Magnesium bisulphite is said to be more stable, more soluble, milder, and more effective in its chemical action than calcium bisulphite.[1]. Its decomposition products are more soluble and it produces a softer and whiter pulp. Quicklime or hydrated lime used in preparing this liquor should have a minimum of 94 per cent. of $CaO + MgO$, a maximum of 5 to 10 per cent. of CO_2, and not more than 3 per cent. of Fe_2O_3, Al_2O_3, SiO_2, and insoluble material.

The acid liquor is also prepared by the Jennsen tower system whereby sulphur gases pass up through a tower packed with limestone. There appears to be some objection to using a limestone high in magnesium, because such material is said to break down and clog the tower, thereby hindering gas absorption. According to Claudet,[2] a limestone for the tower process should preferably have not more than 2½ per cent. of $MgCO_3$, although in some cases 3 per cent. may be tolerated and rarely 5 or 10 per cent. has been allowed. Other impurities should not amount to more than 2½ per cent., and the $CaCO_3$ content should be at least 95 per cent.

Other requirements for limestone are that it shall be virtually free from mica, pyrite, and graphite or other carbonaceous material and that, when dissolved, it will not form a dark scum on the surface of the solution or a sludge.

Exact figures on the quantity of high-magnesium lime sold to sulphite paper mills are impossible to obtain, as many lime producers who sell burned lime to paper mills do not specify the kind of paper mill, and crude dolomite may be bought by paper mills and calcined at the mill. The figures in Table III are an estimate of the quantity and value of high-magnesium lime sold to sulphite paper mills from 1920 to 1929.

Lime Mortars and Plasters.—Lime manufacture consists essentially in the calcination of high-grade limestone, dolomites, or rocks of intermediate composition. High-magnesium limestones and dolomites are used extensively for making lime. The limes of northern Ohio, the most productive lime-burning area in the United States, are nearly all manufactured from a practically pure dolomite.

Lime mortars are used mainly as bonding agents for brick and masonry work, and lime finds extensive utilization in plaster and various synthetic building materials. Such mortar essentially is a mixture of well-slaked lime, sand, and water, to which may be added Portland cement.

The reactions of dolomitic lime and calcium lime differ somewhat in the slaking process. A high-calcium lime expands greatly when water is added and much heat is liberated. Such mortars, however, are likely to be short or relatively nonplastic. Dolomitic lime slakes much more slowly, generates less heat, and the expansion in volume is less, which makes a correspondingly smaller yield. As a rule the dolomitic mortars are more plastic and therefore have a greater sand-carrying capacity. The choice of mortars is often determined by the experience of an individual mason or contractor. Dolomitic-lime mortars have a higher ultimate strength, but this factor need seldom be considered in the selection of a mortar. The chief use of high-magnesium lime is as a finishing-coat plaster, for which it is very popular because of its high plasticity.

TABLE III.—HIGH-MAGNESIUM LIME SOLD BY PRODUCERS IN THE UNITED STATES TO SULPHITE PAPER MILLS, 1920-1929

Year	Short Tons	Value
1920	121,817	$1,347,321
1921	68,992	711,345
1922	70,000	650,000
1923	75,000	750,000
1924	70,000	625,000
1925	53,000	451,000
1926	52,600	482,000
1927	50,000	441,000
1928	46,000	359,000
1929	51,000	398,000

Blast-Furnace Flux.—Cost is the principal factor in the utilization of limestone as a flux in metallurgical operations. This is particularly true in the pig-iron industry, where large quantities of limestone must be used in the reduction of iron ore. Most furnace operators use the cheapest form of limestone available, and the chemical composition, within certain limits, generally is of secondary importance. In smelting iron ores in blast-furnaces the impurities are mainly silica and alumina and, in order to remove these as slag, a basic flux must be added. At the fusion zone about 15 per cent. of the original iron is still in the form of unreduced oxide and, if insufficient flux is employed, some of this iron is lost in the slag. The flux also takes care of the ash left from the combustion of coke, and aids in removing sulphur and other impurities. Dolomite is preferred in the manufacture of ferrosilicon and ferromanganese, because it fluxes off very little of the silica or manganese.

The magnesia content of the slag has an effect upon the subsequent use of such material. Some operators prefer 7 to 10 per cent. of magnesia in slag when it is used for road purposes. The magnesia content, however, is objectionable in any slag which is to be used in the manufacture of cement.

The effect of magnesia on the fluxing action is a question that has received much discussion. In some instances dolomite and high-magnesium limestone appear to increase the viscosity of the slag, whereas in other cases quite opposite results have been obtained.

Glass Works.—Limestone is used in the glass industry as a flux, generally as ground limestone or,

[1] *Lime—Its Use and Value in the Industrial Chemical Processes.* National Lime Assn., Washington, D. C., 1930, 88 pp.

[2] Claudet (H. H.). *Limestone for Pulp and Paper Industry.* Canadian Min. Jour., vol. 49, April 13, 1928, p. 308.

more rarely, as an oxide or hydrate. Magnesium in limestone makes glass somewhat more difficult to melt but sometimes is desired in making certain forms of optical glass. Limestone high in magnesium is said to be preferred where certain types of automatic machinery are employed. Glass manufacturers require a limestone of uniform grade because of the rigid control necessary in handling flux batches. Therefore, either a high-calcium or a dolomitic limestone is preferred because of the greater consistency in chemical composition of these two kinds of material.

Carbon Dioxide and Chemicals.—A few years ago, according to reports of sales received by the United States Bureau of Mines, crude dolomite aggregating about 35,000 tons, and valued at more than $60,000, was used annually in the manufacture of carbon dioxide. Carbon dioxide is used in the manufacture of beverages and in chemical plants such as those producing epsom salts (magnesium sulphate).

Several processes have been patented for producing various magnesium chemicals from dolomite, including magnesium chloride for use in the manufacture of magnesium metal; but, except for plants utilizing carbon dioxide locally, other sources of magnesium, either magnesite or natural salt deposits and brines, are generally considered more economical. Projects utilizing dolomite for the manufacture of Sorel or magnesium-oxychloride cements have likewise been doomed to failure unless the raw material so used contained a substantial admixture of magnesite. The amount of dolomite used in the manufacture of carbon dioxide is shown in Table IV.

TABLE IV.—DOLOMITE SOLD BY PRODUCERS IN THE UNITED STATES FOR THE MANUFACTURE OF CARBON DIOXIDE, 1920-1926

Year	Short Tons	Value
1920	33,040	$ 73,671
1921	34,090	124,984
1922	38,280	58,748
1923	38,460	52,494
1924	34,600	57,105
1925	19,740	36,854
1926	16,520	31,424

The Bureau of Mines is not at liberty to publish figures for 1927-1929.

Agriculture.—Limestone finds wide employment as a soil conditioner and fertilizer. It not only corrects acidity and supplies a valuable plant food but may also add to the porosity of the soil, thereby aiding in proper drainage. For these purposes ground limestone or hydrated lime may be used, and in some instances calcium oxide or quicklime is put on the soil. Opinions differ as to the effect of magnesium compounds, but both magnesium and calcium limestones are used successfully.

Paints, Kalsomine, Etc.—Finely-pulverized limestone and marble flour are used to a considerable extent as paint fillers. Lime is employed in the preparation of resins used in the manufacture of varnish, and hydrated lime is used for kalsomines and whitewash. The relative amounts of calcium and magnesium carbonate are immaterial for most of these uses.

Vienna Lime.—Vienna lime is made from high-magnesium limestone or dolomite, analyzing about 55 per cent. of $CaCO_3$, and 43 per cent. of $MgCO_3$, with traces of iron, silica, and alumina. The rock is grayish white, fine-grained, and contains certain characteristic fossils (gastropods) which are said materially to affect its qualities. The stone is carefully calcined by a secret process, and the lime is cleaned, ground, packed in sealed containers, and sold to manufacturers of buffing compounds.

Vienna lime is used for buffing nickel, brass, copper, pearl, celluloid, and other metal and manufactured articles. It is softer than silica, but generally harder than the artificially-prepared metallic oxides such as crocus, red, green, and black rouges. Eardley-Wilmot[3] states that:

"The most important use is for nickel, and the lime is now recognized as the standard composition for the 'coloring' of nickel after plating, as it gives it a deep 'under-surface' blue peculiar to the metal. Vienna lime cuts faster than crocus and has almost entirely replaced it for all classes of work. Vienna lime should not be used on aluminum, as it attacks it chemically.

"The action of Vienna lime in buffing is not clearly known, but it is believed that the heat generated on the buff causes a caustic action due mainly to the lime, and the magnesia does the work, as it helps to drag and create the necessary friction, but an excess of lime would cause it to slip too readily. As soon as the lime becomes hydrated it ceases to function and also attacks the grease compositions."

Ceramics.—Limestone is used to a certain extent in the manufacture of pottery and porcelain ware. It is used in the form of a carbonate as a levigated natural whiting, as a hydrate, or as an oxide. Its function is to aid in fluxing the various materials, and for some purposes a relatively high-magnesia content is preferable. In other cases a high-calcium content is desired.

Prepared Whiting.—Magnesium lime is used in preparing a very fine-grained pigment for coating paper. The iron content must be very low, as a pure white color is demanded. This pigment is made by adding sodium carbonate to a suspension of freshly-slaked magnesium lime.

Rubber.—Dolomite or high-magnesium limes are used as hardening agents in the manufacture of soft-rubber goods. High-calcium limes have a similar application in making hard-rubber products. Both kinds of lime are also used to some extent as accelerators in the vulcanizing process.

Tanneries.—At the depilatory stage of leather tanning lime is used extensively. Ordinarily, any magnesium oxide present is objectionable because it tends to give a "harsh" or "rough" leather. In the manufacture of morocco leather, however, magnesium lime is preferred.

Fungicides.—Either a magnesium or calcium-lime hydrate may be used in preparing dry-mix sulphur-lime which is used as a fungicide.

Other Uses.—Other minor uses include the employment of a limited amount of hydrated lime in pig-iron casting, in "pickling" iron and steel, and in wire-drawing. Some is also used in the manu-

[3] Eardley-Wilmot (V. L.). *Abrasives, Part I: Siliceous Abrasives.* Canada Dept. Mines Branch 673, 1927, p. 97.

facture of straw-board. Either a magnesium or a calcium lime may be used.

Uses Depending on Physical Properties

Building Stone.—Requirements of building stone depend principally upon physical rather than chemical properties. Usually any limestone which has the right physical characteristics, such as homogeneity of structure, high density, low porosity, and pleasing color, will serve as a good building stone, irrespective of the percentage of magnesium carbonate which it contains. It is held, however, by some authorities that a true dolomite is better than a so-called magnesium limestone because of the slight difference in solubility between calcium carbonate and magnesium carbonate. Sulphurous gases in the atmosphere may cause crystals of calcium sulphate and magnesium sulphate to form which are likely to grow and disrupt the stone. Many deposits consisting of alternate layers of calcite and dolomite do not yield rock satisfactory for building material. The governing factor here seems again to be one of homogeneity.

Many commercial marbles contain varying amounts of magnesium carbonate and some are nearly pure dolomite.

Crushed Stone.—The enormous amounts of crushed stone used annually for concrete aggregate, road stone, and railroad ballast make this market outlet one of the most important. Here again physical characteristics are paramount and little attention need be paid to the chemical composition except in so far as experience may prove in a given locality or deposit that a different chemical composition indicates a corresponding difference in physical characteristics. Where this is the case it logically follows that close attention must be paid to any variations in chemical composition. With crushed stone, too, because of its relatively low price, other factors, such as availability and proximity to markets, are usually more important.

Coal-Mine Dusting.—To decrease the hazard of dust explosions in coal mines, finely-ground limestone may be liberally applied to the walls, floors, and roofs of the various entries and rooms. For this purpose the chemical content is immaterial, and either a magnesium or calcium limestone may be used.

Asphalt Filler.—Asphalt used for paving and roofing consumes a relatively large quantity of finely-pulverized limestone. For this market the physical characteristics are important and particular consideration is given to grinding and sizing. Owing to this added cost of manufacture, the material commands a somewhat higher price and therefore may be transported to a considerable distance for use. Either a magnesium or calcium limestone may be used.

Miscellaneous Uses.—Minor uses of limestone, the requirements of which are similar to those of building stone, include stone used for curbing, flagging, paving, rubble, riprap, roofing gravel, stucco, terrazzo, and artificial stone.

Other minor uses are for filter beds, poultry grit, and lithographic stone, of which the German variety is a fine-grained magnesium limestone.

Uses Depending on High Calcium

Portland and Natural Cement.—Limestone is one of the major raw materials used in the manufacture of Portland and natural cements. Such stone, however, must be low in magnesium content, the usual tolerance being about 5 per cent. of MgO.

Water Purification.—Much of the water used for domestic and industrial purposes is treated to remove calcium or magnesium carbonate that has been dissolved and held in solution by carbon dioxide absorbed from the atmosphere. Lime added to the water combines chemically with the excess carbon dioxide, forming calcium carbonate, which together with the calcium carbonate previously held in solution is thereby precipitated and subsequently removed by filtration or by decantation. A high-calcium lime generally is preferred for treating water and may be used either as quicklime or as hydrated lime.

Sand-Lime Brick.—Sand-lime bricks are made by mixing sand with a small percentage of hydrated lime (usually about 8 per cent.) and then molding to form in heavy presses. Subsequently the bricks are allowed to harden under steam pressure. This results in brick consisting essentially of sand which is cemented together by calcium silicate. For this purpose the lime used must be very low in magnesium.

Silica Brick.—Silica brick, which is used for a refractory in furnace linings, differs from sand-lime brick in the curing process. Silica bricks consist of silica bonded with hydrated lime, after which the mixture is molded, carefully dried, and then burned in a special type of kiln. For this purpose the lime should have at least 92 per cent. available calcium oxide and not more than 3 per cent. available magnesium oxide.

Calcium-Carbide Works.—In the manufacture of calcium carbide, limestone is calcined and melted in an electric furnace with carbon in the form of coke, charcoal, or coal. A high-calcium limestone must be used because magnesium is objectionable. The usual requirements are that the stone shall have less than 2 per cent. of MgO, 0.01 per cent. of phosphorus, and 3 per cent. of silica.

Sugar Refineries.—Lime is used extensively in the refining of sugar. Magnesia is objectionable and only high-calcium limes are employed. Sugar refiners may purchase raw limestone and burn their own lime. Such stone should contain less than 1 per cent. of silica and less than 1 per cent. of magnesia.

Cyanide Process.—In the recovery of gold and silver by the cyanide process quicklime or milk of lime is added to impart what is known as "protective alkalinity." Experiments with dolomite have shown that the latter should not be substituted for this purpose.

Basic Open-Hearth Steel Flux.—A limestone flux, varying from 6 to 12 per cent. of the basic open-hearth furnace charge, is added mainly for the removal of phosphorus and sulphur. As magnesium is a poor phosphorus remover, the maximum permissible content of MgO is usually fixed at 5 per cent.

Accident Frequency in Sand-and-Gravel Plants Shows Marked Decline*

By W. W. ADAMS
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LOWER accident rates were the outstanding feature of the second annual sand-and-gravel safety competition conducted in 1930 by the United States Bureau of Mines in coöperation with the National Sand & Gravel Assn. Both the frequency and severity rates for accidents were greatly reduced as compared with those shown by the first year's contest, that for 1929. Three times as many plants were enrolled, and the number of man-hours of work represented was more than doubled.

Seventy-six sand-and-gravel plants, situated in 20 states, participated in the competition, as compared with 26 plants, located in 13 states, in the year before. The number of man-hours of employment, which indicated the amount of exposure to occupational hazards, was 4,915,592, an increase of more than 100 per cent. over the previous year's total of 2,259,572 hr. The frequency of accidents declined from 74.4 per 1,000,000 hr. for all plants enrolled in the first year's contest to 42.7 per 1,000,000 man-hr. for all plants enrolled in 1930. The accident-severity rate was reduced from 9.7 days of disability per 1,000 man-hr. of exposure in 1929 to 5.9 days of disability per 1,000 man-hr. of exposure in 1930.

The actual number of accidents reported for 1930 by 76 plants included 4 deaths and 206 injuries, whereas the 26 plants that were enrolled in 1929 reported 3 fatalities and 165 injuries.

Under the rules of the contest all "lost-time" injuries are reported—that is, all injuries that disable an employee for more than the remainder of the day on which the accident occurred. If the employee is physically able to resume his work on the day following the accident, the injury is not classed as a lost-time injury.

The contest covered accidents and man-hours worked by all employees at the plant who were employed by the same company, and included work up to the point of delivery of the material directly to the consumer or to an independent agency of transportation—in other words, to the point of relinquishment of control of the material by the producer.

Two trophies are awarded to the winning companies in the sand-and-gravel safety contest each year. Awards are made on the basis of reports of accidents and man-hours worked, which the companies furnish to the Bureau of Mines. These trophies do not become the permanent property of the winning companies but are held for one year and then are transferred to the winners of the succeeding year's contest. All sand-and-gravel plants, regardless of size, that are members of the National Sand & Gravel Assn. are eligible to enroll in the contest, but, for the purpose of awarding the trophies, the plants are divided into two classes: first, those that worked 100,000 or more man-hr. during the contest year and, second, those that worked fewer than 100,000 man-hr.

First place among the larger plants in 1930 was won by the Missouri River plant of the Stewart Sand & Material Co., at Kansas City, Mo. This plant is a river-deposit operation and its record for the calendar year 1930 showed 108,753 man-hr. of work without an accident causing loss of time to an employee. Second place among the larger plants was won by the Manor plant of the Warner Co. through the operation of the company's lake-deposit plant at Tullytown, Pa. This plant had a record of 225,852 man-hr. with only two employees injured; these injuries, both temporary in character, caused a total of 24 days of disability, thus indicating an accident-severity rate equal to 0.106 lost days for each 1,000 man-hr. of exposure to hazard.

Among the smaller plants—those working fewer than 100,000 man-hr.—first place was won by the Potts-Moore Gravel Co., whose bank-deposit plant at Waco, Tex., was in operation for 79,881 man-hr. without a lost-time injury. Second place in this group was won by Jahncke Service (Inc.) for operating its plant at Roseland, La., for 71,246 man-hr. without a lost-time injury.

TABLE I.—SCALE OF TIME LOSSES FOR WEIGHTING DEATHS AND PERMANENT INJURIES TO SHOW SEVERITY OF ACCIDENTS

Nature of Injury	Degree of Disability in Percentage of Permanent Total Disability	Days Lost
Death	100	6,000
Permanent total disability	100	6,000
Arm above elbow, dismemberment, or permanent disability of	75	4,500
Arm at or below elbow, dismemberment, or permanent disability of	60	3,600
Hand, dismemberment or permanent disability of	50	3,000
Thumb, any permanent disability of	10	600
Any 1 finger, any permanent disability of	5	300
2 fingers, any permanent disability of	12½	750
3 fingers, any permanent disability of	20	1,200
4 fingers, any permanent disability of	30	1,800
Thumb and 1 finger, any permanent disability of	20	1,200
Thumb and 2 fingers, any permanent disability of	25	1,500
Thumb and 3 fingers, any permanent disability of	33⅓	2,000
Thumb and 4 fingers, any permanent disability of	40	2,400
Leg above knee, dismemberment, or permanent disability of	75	4,500
Leg at or below knee, dismemberment, or permanent disability of	50	3,000
Foot, dismemberment, or permanent disability of	40	2,400
Great toe, or any 2 or more toes, any permanent disability of	5	300
1 toe, other than great toe, any permanent disability of	0	....
1 eye, loss of sight	30	1,800
Both eyes, loss of sight	100	6,000
1 ear, loss of hearing	10	600
Both ears, loss of hearing	50	3,000

Temporary disabilities are weighted according to actual calendar days of disability, including Sundays and holidays if injured employee's disability actually continues on those days; that is, all days will be counted except day of accident and day of employee's ability to return to duty. Hernia is classed as a temporary disability to be charged with the actual number of calendar days during which the employee was physically unable to work.

* Reprinted from U. S. Bureau of Mines Report of Investigations 3133.

TABLE II.—COMPARATIVE DATA FOR EACH TYPE OF THE 76 PLANTS COMPETING IN THE SAFETY CONTEST OF 1930

Type of Plant	Number of Plants	Man-hours	Accident Rates	
			Frequency	Severity
Marine, lake	4	648,907	38.526	.391
Wet pit, and river	2	174,151	45.937	.924
Dry pit	4	209,972	33.338	1.514
River	35	1,925,899	30.116	3.808
Bank	22	1,104,694	62.461	7.015
Wet pit	9	851,969	50.471	15.443
Total, 1930	76	4,915,592	42.721	5.894
Total, 1929	26	2,259,572	74.350	9.713

The trophies for 1930 will be presented to the Stewart Sand & Material Co. and the Potts-Moore Gravel Co. at a time and place to be determined. In calculating the accident-severity rates, which reflect the number of days of disability from accidents, each death and permanent total disability is charged with 6,000 lost days as shown in Table I. The table and notes appended thereto also show the loss of time charged against injuries of a permanent, partial, or temporary nature.

In order to determine the relative hazards of the various types of sand-and-gravel operations, all the plants that took part in the safety contest of 1930 were classified according to the kind of deposit from which the sand and gravel were obtained, as follows:

1. Dry bank
2. Pit
   (a) Dry
   (b) Wet
3. Marine
   (a) River
   (b) Natural lake
   (c) Ocean

In this classification a dry bank is defined as a sand-and-gravel operation where the deposit lies at a greater elevation than the working level of the plant; a pit is a plant where the deposit is lower or beneath the working level. A pit may be wet or dry; if wet, it may be by artificial or natural flooding. A marine plant is one where the deposit lies under a river, natural lake, or ocean.

Two operations did not fall in any of these groups and were classified under the combined heading "wet pit, and river" plants.

Comparative data for each type of operation represented in the safety contest are given in Table II for the 76 plants which reported for 1930.

The accidents on which the rates in Table II are based were classified as follows:

Classification of Accidents

Type of plant	Fatal	Permanent		Temporary	Total
		Total	Partial		
Lake	..	..	..	25	25
Wet pit, and river	..	..	..	8	8
Dry pit	..	..	..	7	7
River	1	..	..	57	58
Bank	1	..	1	67	69
Wet pit	2	..	1	40	43
Total, 1930	4	0	2	204	210
Total, 1929	3	0	2	163	168

Classification of Accidents by Days Lost

Type of plant	Fatal	Permanent		Temporary	Total
		Total	Partial		
Lake	.....	..	....	254	254
Wet pit, and river	.....	..	....	161	161
Dry pit	.....	..	....	318	318
River	6,000	..	....	1,333	7,333
Bank	6,000	..	300	1,449	7,749
Wet pit	12,000	..	600	557	13,157
Total, 1930	24,000	00	900	4,072	28,972
Total, 1929	18,000	00	1,500	2,447	21,947

The best safety record, as far as frequency of accidents is concerned, was for river-deposit operations. Next in order, and almost as good, was the record for dry pits. Ranking third, and only slightly less favorable, were the lake-deposit operations. Each of these three classes of plants had an accident-frequency rate better than the average for all the 76 plants combined. Somewhat higher than the general average were the accident-frequency rates for wet pits and banks.

A similar comparison based upon accident-severity rates is given in the foregoing table, although the figures are perhaps not typical because the group rates are affected greatly by the scale charges of lost days for deaths and permanent injuries and the relatively small number of man-hours of employment in each group of plants.

From the records submitted to the United States Bureau of Mines in connection with the contests of both 1929 and 1930, it seems reasonable to say that, as among operations of the bank, wet pit, and river types, the river plants have the most favorable safety record as far as accident frequency is concerned. Wet pits appear to rank second and bank-deposit plants third. Records for other types of plants are too meager, as yet, to form a basis for comparison.

TABLE III.—CAUSES OF ACCIDENTS AT SAND-AND-GRAVEL PLANTS IN 1930

Cause	Dry Bank		Dry Pit		Wet Pit		Natural Lake		River		Wet Pit and River		Total	
	Accidents	Days Lost	Accidents	Days Lost	Accidents	Days Lost	Accidents	Days Lost	Accidents	Days Lost	Accidents	Days Lost	Accidents	Days Lost
Machinery	14	6,350	1	234	8	6,689	3	20	5	170	1	49	32	13,512
Haulage	6	263	1	1	3	20	4	52	4	223	..	..	18	559
Explosions	..	....	..	..	..	....	..	..	1	23	..	..	1	23
Electricity	..	....	..	..	1	3	2	7	..	....	..	..	3	10
Fires	1	144	..	..	..	....	..	..	..	....	..	..	1	144
Hot substances	4	20	2	18	..	....	1	4	3	45	..	..	10	87
Falls of persons	5	87	1	49	3	19	1	10	12	333	4	42	26	540
Stepping on or striking against objects	8	201	..	..	1	12	3	26	7	70	..	..	19	309
Falling objects (not being handled by injured)	5	72	..	..	5	30	..	..	4	183	..	..	14	285
Handling of objects	19	570	..	..	13	297	7	77	9	165	2	63	50	1,172
Hand tools	3	9	..	..	6	73	3	8	4	24	1	7	17	121
Animals	1	28	..	..	..	....	1	50	1	2	..	..	3	80
Drowned	..	....	..	..	1	6,000	..	..	1	6,000	..	..	2	12,000
Miscellaneous causes	3	5	2	16	2	14	..	..	7	95	..	..	14	130
Total	69	7,749	7	318	43	13,157	25	254	58	7,333	8	161	210	28,972

In 1930 nine plants of the wet-pit type, operating 851,969 man-hr., had an accident-frequency rate of 50.47 per 1,000,000 man-hr., as compared with a rate of 68.82 per 1,000,000 man-hr. for ten similar plants that operated 1,122,207 man-hr. in 1929.

For bank plants an average rate of 62.46 was reported by 22 operations that worked 1,104,694 hr., as compared with a rate of 86.69 for 12 plants that operated 967,514 hr. in the preceding year.

Among sand-and-gravel operations of the river type, four plants competed for the safety trophies during both years' contests; these four plants reduced their accident-frequency rates from 74.829 in 1929 to 37.187 in 1930. These figures represent 200,000 man-hr. of exposure in 1929 and 188,000 man-hr. in 1930.

Seven identical wet-pit plants whose volume of employment was 823,000 man-hr. in 1929 and 638,000 in 1930 had an accident-frequency rate of 53.485 in the first year and 53.264 in the second year.

Eight identical plants of the bank-deposit type, representing 608,000 man-hr. in 1929 and 487,000 hr. in 1930, had a frequency rate of 34.525 in the first year's contest and 34.899 in the second year's contest.

Of the 4 men killed during 1930 one was a clamshell engineer. He was near the loading track, loading sand and, in attempting to tighten a cable, he was caught by the cable and wound on the drum. Both his legs were broken and he died as a result of his injuries.

An oiler employed at a wet-pit plant, while working at a gravel screen, died as a result of injuries which he received when his clothing became caught and wound around a moving shaft, the man being pulled around the shaft.

A dredge helper was drowned when he fell off a pontoon line into 60 ft. of water.

A night watchman was drowned, the cause of the accident being unknown.

Because of these four fatalities, each of which is considered to be the equivalent of 6,000 lost days, the year's record for the contest as a whole shows that the largest loss of time from accidents was due to machinery and drownings. From the viewpoint of the number of persons injured, however, the principal causes of accidents were handling of objects, machinery, falls of persons, stepping on or striking against objects, haulage, and hand tools. These six classes of accidents covered 77 per cent. of the total number reported by all companies. These facts are shown in Table III.

There was a rather wide variation in the average duration of disability from temporary lost-time accidents at the different types of sand-and-gravel plants. At lake plants, for example, an employee meeting with an accident causing a temporary injury lost an average of 10 days. The average for injured employees at wet-pit plants was 14 days; at bank plants it was 22 days, and at river plants it was 23 days. These are the averages for plants that reported for 1930; the figures should not be accepted as necessarily typical until similar figures for more than one year become available.

Method and Apparatus for Flexural Tests on Concrete

V. L. Glover, engineer of materials, Illinois Division of Highways, in a report on the Development of Method and Apparatus for the Flexural Test of Concrete, reviews the flexural-test problem in an interesting and thorough manner. Some of the subjects discussed are: (1) Objections to flexural tests; (2) Development of the flexural test with portable field apparatus; (3) Historical review; (4) Circumstances from which flexural testing by the cantilever method originated; (5) Construction and use of the first cantilever extension arm (Jan., 1922); (6) First use in field testing in 1923; (7) Portable dynamometer-type machines. Then follows a detailed description of the investigation made by the Illinois Division of Highways, from which the present machine was adopted. Table I shows the results of some of the tests included in this investigation.

TABLE I.—COMPARISON OF MODULUS OF RUPTURE BY DIFFERENT METHODS OF LOADING

Method of Loading	Distance Between Top Points of Contact (*in.*)	Span-Distance Between Beam Supports (*in.*)	Rate of Application of Load (*lb. per sq. in. per sec.*)	Comparative Modulus of Rupture (*per cent.*)
Simple beam	0	24	8.3	100
1/3 Point	4	24	8.1	97
1/3 Point	6	18	6.6	91
1/3 Point	8	24	4.6	82
1/3 Point	16	48	3.2	77

These tests were made on 6-in. by 6-in. by 60-in. concrete specimens, which made possible different loadings on the same specimen.

There is strong evidence, in the ⅓-point loadings, that the shorter the span, the greater is the modulus of rupture. Also if a beam is loaded with two loads close together near the center, the modulus of rupture approaches that of a single beam.

The rate of application of the load shows a very close relation to the comparative modulus of rupture, the modulus increasing as the rate of loading increases.

There were 21 variations in loading, including 12 different systems of loading, studied in this investigation.

TABLE II.—EFFECT OF CROSS SECTION OF SPECIMEN ON MODULUS OF RUPTURE

Size of Beam Cross-Section (*in.*)	Modulus of Rupture (*lb. per sq. in.*)	Rate of Application of Stress (*lb. per sq. in. per sec.*)	Span (*in.*)
6 by 6	550	23.5	24
8 by 8	552	15.7	24
4 by 12	652	37.8	24
8 by 12	563	13.6	24

These tests were made on a 200,000-lb. Riehle machine with constant loading speed. The simple beam mid-point loading method of testing was used. The beams were tested with the small dimension placed vertically whenever the cross section was not square. The results are shown in Table II.

"Except in the case where the depth of the beam was so small that it affected the moment of inertia, and consequently, also the rate of application of stress, to a very high degree, the modulus of rupture of the various sizes of beams was very nearly the same," says Mr. Glover.

Turns Out Batched Aggregate at Power Cost of One Cent per Ton

FOR several years P. W. Lambert & Co., Inc., have operated a builders' material supply-yard on the Rahway River, Linden, N. J., receiving crushed stone, sand and gravel by barges and shipping out by trucks. Their present dock frontage is 480 ft. A traveling crane on the dock unloads the barges and delivers the materials to bins or stock-piles. This crane was built by the Lambert Hoisting Engine Co. and is known as a Class B, traveling, full-circle revolving electric crane. It has a 90-ft. boom and a 2½-cu. yd. clam-shell bucket with a 225-hp. hoisting motor, a 40-hp. swinging motor, and a 40-hp. revolving motor, all made by General Electric.

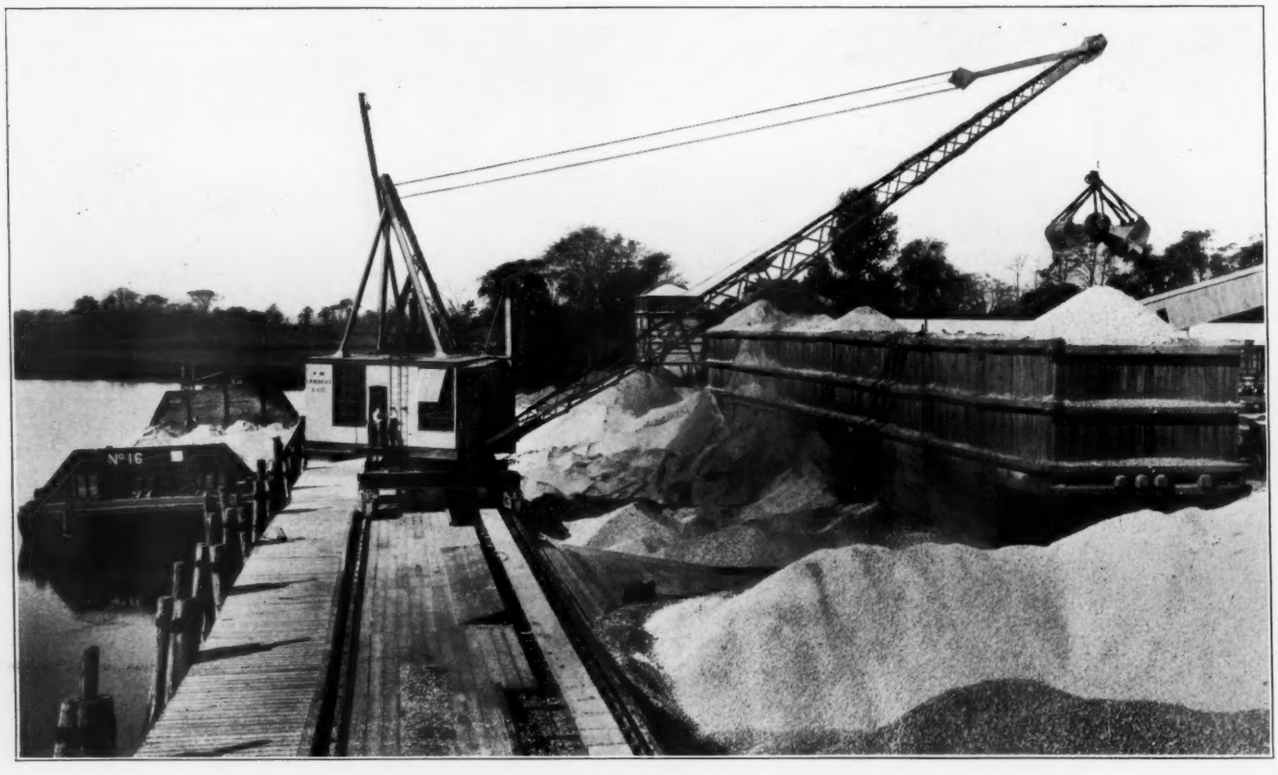
The storage bins, eleven in number, each with a capacity of 150 tons, are of timber, flat-bottomed, and lie parallel to and about 50 ft. back from the face of the dock. Trucks back under these bins and are loaded through overhead quadrant gates, of which there are three to a bin. There are also two two-compartment batcher bins in the yard which can be filled by the traveling crane. A Barber-Greene bucket-loader is used for loading special sized material from stock-piles.

Early in 1930 the company decided to install a modern and more adequate batching plant and to make provision for delivering transit- or ready-mixed concrete. A 4-compartment, 300-ton Blaw-Knox bin was erected opposite and about 225 ft. away from one end of the timber storage-bins. This was set high enough not only to allow for scales and hoppers for batching for concrete road work and transit-mixed concrete but also to allow the later installation of a 3-cu. yd. mixer for pre-mixed wet concrete.

Belt-conveyors carry the sand, stone and gravel from the storage-bins to the new batcher bin. One belt-conveyor, 120 ft. long, resting on the sills of the bents, was installed under the back row of gates under the bins. Special hinged chutes or hoppers guide the materials from the gates to the belt, obviating the need of any skirt-boards or fixed hoppers. Only one of these hinged chutes is on the belt at a time, all the others being raised clear of it.

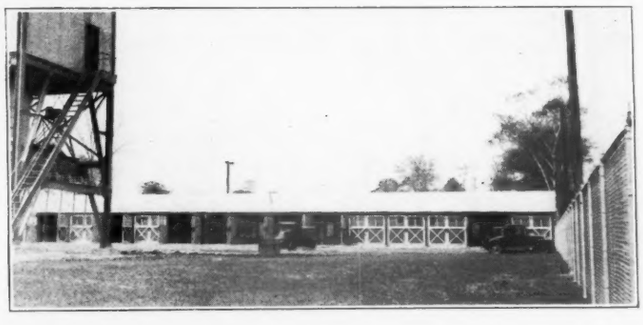
This first conveyor discharges to a 260-ft. belt-conveyor set at right angles to it and running up on an inclination of 16 deg. to a point 19 ft. above the top of the batcher bin, 70 ft. above the ground, where it discharges into a swiveling chute.

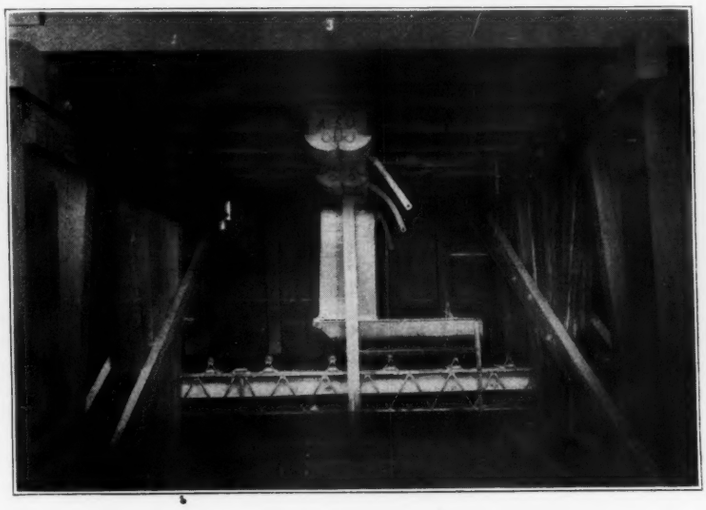
A third belt-conveyor, 55 ft. long, takes cement in bulk from a cement shed, located under the 260-ft. conveyor, to a hopper on the operator's platform of the batcher bin. Cement is stored in bags in the shed and proportioned by weight in a weighing hopper installed at one end of the shed over the tail end of the conveyor. When running on ready-mixed concrete, a batch of cement is kept on the belt, the



Electric crane on dock loading from barges to storage bins.

Above—One of the trucks which mix the material in transit. *Right*—Looking down the cement conveyor in the cement-storage shed. *In Circle*—Swinging chute under the batching hoppers. *Right Center*—A view of the plant garages. *Lower Left*—Batching gates and the conveyor. *Lower Right*—P. W. Lambert, head of the concern.



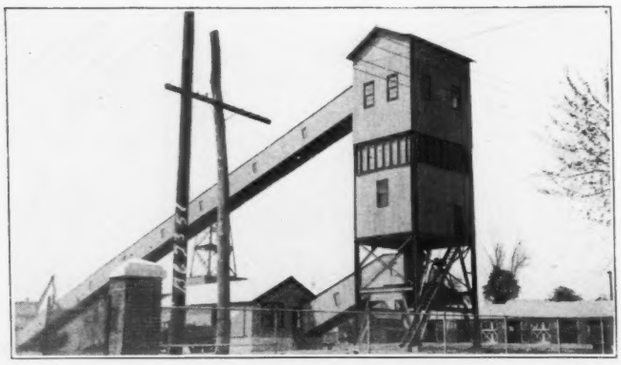


General view of the P. W. Lambert plant.

starting and stopping of which are controlled by the operator at the batcher plant.

Under the weighing hopper of the batcher plant is an ingenious swinging chute developed by the Lambert company and so arranged that the measured batch of dry aggregates can be diverted either into any one of four batch-boxes for loading multi-batch trucks on concrete road work, or to a special hopper where cement can be added, discharging into transit-mix trucks, or, when it is installed, to a mixer for wet concrete.

All the belt-conveyors used here were furnished by the Barber-Greene Co. and are of the standard steel-frame, Warren truss type of construction—24-in. belt running on 3-roll troughing carriers. The capacity of these has worked out at approximately 225 tons of sand or stone per hour. No housing was required over the 120-ft. conveyor as it is located under the storage bins. The 260-ft. conveyor and the cement conveyor rest on the floor beams of galleries about 7 ft. high by 7 ft. wide, inside dimensions, the sides of which are double-latticed timber



A view of the batching plant.

trusses, both sides and roof being covered with corrugated galvanized sheathing. Two intermediate steel towers support the gallery for the 260-ft. conveyor, the longest span being about 83 ft. Around the base of one of these towers is a brick building containing a boiler-plant for heating water for concrete in cold weather.

In spite of the necessity of shutting and opening gates and raising and lowering chutes under the storage bins and of changing the position of the swivel spout at the discharge end of the 260-ft. conveyor each time one compartment of the batcher plant is filled, the operation is done without stopping the plant and usually without extra help. When the man stationed on the platform over the batcher bins sees that one compartment is nearly full, he runs down the long conveyor gallery, closes the then open gate, raises that hinged hopper, lowers the hinged hopper under the storage bin from which he wishes to draw, opens that gate, jumps on the moving belt and rides up ahead of the material to his platform, where he swings the swivel spout around to discharge into the proper compartment.

Starting in last year with four transit-mixing trucks, the company now has eight 3-cu. yd. Jaeger mixer bodies mounted on Mack chassis, in addition to seven Macks with dump bodies. A new garage 224 ft. long, with fifteen double doors on the front, has recently been completed.

All the belt-conveyors are electrically driven by General Electric motors. The drive of the 260-ft. conveyor includes a 30-hp., 1,200-r.p.m., slip-ring type motor, with resistance starter and push-button control, a Jones herringbone gear speed-reducer, automatic differential brake, and return belt cleaner. All hoppers and chutes of the conveying system have renewable high-carbon-steel liners.

While the plant has seldom been pushed to capacity output, in 25 days of July 32,071 tons of batched aggregate was turned out. The company's power bill for this period, including the electric crane on the dock, was $321.60, approximately 1 c. per ton. No costs on the entire operation are available, but for handling from barge to batcher bins, labor and power costs usually run under 3 c. per ton.

Inter-Quarry Competitions Held at Leicestershire, England

In the presence of more than 1,000 spectators the Leicestershire inter-quarry competitions were held at the Whitwick Granite Quarry, near Coalville, Leicestershire, England, during the afternoon of Sept. 26. The competitions—the first of their kind ever held in England—were arranged by the Leicestershire granite-quarry owners in conjunction with the Amalgamated National Union of Quarryworkers and Settmakers to stimulate interest and to cement further the good relations which exist between the employers and their workmen.

(*Continued on page 68*)

Contestants connecting up the air lines.

Trade-Practice Rules for Lime Industry Approved by Federal Commission

A TRADE Practice Conference for the lime industry was held at the Hotel Mayflower, Washington, D. C., June 27, 1929, under the direction of Commissioner William E. Humphrey, of the Federal Trade Commission, assisted by M. Markham Flannery, director of Trade Practice Conferences, and Stephen C. Van Fleet, assistant director. Approximately 70 per cent. of the total tonnage of lime manufactured was represented.

After the objects, purposes and procedure were explained, the conference discussed and adopted 24 resolutions dealing with various trade or business practices. The commission, after consideration, has reworded some of these resolutions and has divided them into Group I and Group II. Those in Group I the commission has approved and those in Group II the commission has accepted as expressions of the trade. The commission declined to approve or accept Rule 12 (Group II), as published Oct. 25, 1929, and the industry's resolutions numbered 23 and 24, designated as "exhibits" in the statement published Oct. 25, 1929. The commission also declined to approve or accept Resolutions 15, 17 and 19, as adopted by the industry.

The commission has directed that notice be given that, in referring to or quoting trade-practice-conference rules, the form in which they appear in the commission's official statement be followed with reference to wording, grouping, numbering and lettering. The rules, as approved, follow:

Rule 1.—It is an unfair trade practice for any person engaged in interstate commerce, in the course of such commerce, either directly or indirectly, to discriminate in price between different purchasers of commodities, where the effect of such discrimination may be substantially to lessen competition or tend to create a monopoly in any line of commerce: Provided, that nothing herein contained shall prevent discrimination in price between purchasers of the same class on account of differences in the grade, quality, or quantity of the commodity sold, or that make only due allowance for differences in the cost of selling or transportation or discrimination in price in the same or different communities made in good faith to meet competition; and provided, further, that nothing herein contained shall prevent persons engaged in selling the products of this industry in commerce from selecting their own customers in *bona fide* transactions and not in restraint of trade.

Rule 2.—The secret payment or allowance of rebates, refunds, commissions, or unearned discounts, whether in the form of money or otherwise, or secretly extending to certain purchasers special services or privileges, not extended to all purchasers under like terms and conditions, with the intent and with the effect of injuring a competitor and where the effect may be substantially to lessen competition or tend to create a monopoly or unreasonably to restrain trade, is an unfair trade practice.

Rule 3.—Maliciously inducing or attempting to induce the breach of existing contracts between competitors and their customers by any false or deceptive means whatsoever, or interfering with or obstructing the performance of any such contractual duties or services by any such means, with the purpose and effect of unduly hampering, injuring, or embarrassing competitors in their businesses, is an unfair trade practice.

Rule 4.—The selling of goods below cost with the intent and with the effect of injuring a competitor and where the effect may be substantially to lessen competition or tend to create a monopoly or unreasonably to restrain trade, is an unfair trade practice.

Rule 5.—The defamation of competitors by falsely imputing to them dishonorable conduct, inability to perform contracts, questionable credit standing, or by other false representations, or the false disparagement of the grade or quality of their goods, with the tendency and capacity to mislead or deceive purchasers or prospective purchasers, is an unfair trade practice.

Rule 6.—To violate the provisions of the Act of Congress approved Aug. 23, 1916, Pub. No. 228, 64th Congress, entitled "An Act to Standardize Lime Barrels" is an unfair trade practice.

[The statute (see U. S. Code, Vol. 44, Part I, of the U. S. Statutes at Large, Title 15, Chap. 6, sections 237-242, inclusive) contains the following provisions:

"Sec. 237.—There is established a large and small barrel of lime, the large barrel to consist of 280 lb. and a small barrel to consist of 180 lb., net weight.

"Sec. 238.—It shall be unlawful for any person to sell or offer for sale lime imported in barrels from a foreign country, or to sell or offer for sale lime in barrels for shipment from any state or territory or the District of Columbia to any other state or territory or the District of Columbia, unless there shall be stenciled or otherwise clearly marked on one or both heads of the small barrel the figures '180 lb. net' and on the large barrel the figures '280 lb. net' before the importation or shipment, and on either barrel, in addition, the name of the manufacturer of the lime and where manufactured, and, if imported, the name of the country from which it is imported.

"Sec. 239.—When lime is sold in interstate or foreign commerce in containers of less capacity than the standard small barrel, it shall be sold in fractional parts of said standard small barrel, and the net weight of lime contained in such container shall by stencil or otherwise be clearly marked thereon, together with the name of the manufacturer thereof, and the name of the brand, if any, under which it is sold, and, if imported, the name of the country from which it is imported.

"Sec. 240.—Rules and regulations for the enforcement of Sec. 237 to 242 inclusive, not inconsistent with the provisions of said sections, shall be made by the director of the Bureau of Standards and approved by the secretary of commerce and such rules and regulations shall include reasonable variations or tolerances which may be allowed.

"Sec. 241.—It shall be unlawful to pack, sell or offer for sale, for shipment from any state or territory or the District of Columbia to any other state or territory or the District of Columbia, any barrels or other containers of lime which are not marked as provided in Sec. 238 and 239, or to sell, charge for, or purport to deliver from any state or territory or the District of Columbia to any other state or territory or the District of Columbia, as a large or small barrel or a fractional part of said small barrel of lime, any less weight of lime than is established by the provisions of Sec. 237 to 242 inclusive, and any person guilty of a violation of the provisions of Sec. 237 to 242 inclusive, shall be deemed guilty of a misdemeanor and be liable to a fine not exceeding $100.

"Sec. 242.—It shall be the duty of each district attorney, to whom satisfactory evidence of any violation of Sec. 237 to 242 inclusive, is presented, to cause appropriate proceedings to be commenced and prosecuted in the United States court having jurisdiction of such offense."]

Rule 7.—To sell lime or permit it to be sold in used barrels bearing the brand, label or name of producers or dealers other than the one producing or selling the lime contained

therein, where the effect may be to mislead or deceive purchasers or prospective purchasers as to source of production, grade, quality or quantity of such product, is an unfair trade practice.

Rule 8.—The sale or offering for sale of any product of the industry by any false means or device which has the tendency and capacity to mislead or deceive customers or prospective customers as to the quantity, quality, substance or size of such product, is an unfair trade practice.

Rule 9.—The imitation of the trade-marks, trade-names, slogans, or other marks of identification of competitors, having the tendency and capacity to mislead or deceive purchasers or prospective purchasers, is an unfair trade practice.

Rule 10.—The false marking or branding of products of the industry with the effect of misleading or deceiving purchasers with respect to the quantity, quality, grade or substance of the goods purchased, is an unfair trade practice.

Rule 11.—The making or causing or permitting to be made or published any false, untrue, or deceptive statement by way of advertisement or otherwise concerning the grade, quality, quantity, substance, character, nature, origin, size or preparation of any product of the industry having the tendency and capacity to mislead or deceive purchasers or prospective purchasers, is an unfair trade practice.

Rule 12.—Directly or indirectly to give or permit to be given or offer to give money or anything of value to agents, employees, or representatives of customers or prospective customers or to agents, employees, or representatives of competitors' customers or prospective customers, without the knowledge of their employers or principals, as an inducement to influence their employers or principals to purchase or contract to purchase industry products from the maker of such gift or offer, or to influence such employers or principals to refrain from dealing or contracting to deal with competitors, is an unfair trade practice.

Rule 13.—To ship lime or lime products on consignment with the intent and with the effect of injuring a competitor, and where the effect may be substantially to lessen competition or tend to create a monopoly or unreasonably to restrain trade, is an unfair trade practice.

Rule 14.—Deviation from the established standards of the industry by any deceptive or false means or device with the effect of misleading or deceiving purchasers or prospective purchasers is an unfair trade practice.

Rule A.—It is the judgment of the industry that each member should install a proper and accurate method for determining his cost.

Rule B.—It is the opinion of the industry that lime manufacturers should use their best efforts to observe these rules of approved practices.

Rule C.—A jobber or distributor shall be defined as any person, firm or corporation who is engaged in the business of selling lime or lime products, either exclusively or with other materials, but is not engaged in the manufacture of the particular type or class of lime or lime products, and who sells the materials to another person, or to another firm or corporation for the purpose of resale.

Rule D.—(a) The industry approves the practice of each individual member of the industry independently publishing and circulating to the purchasing trade its own price lists.

(b) The industry approves the practice of making the terms of sale a part of all published price schedules.

Rule E.—A Committee on Trade Practices is hereby created to coöperate with the Federal Trade Commission and to perform such acts as may be proper to put these rules into effect.

Attention is called to Federal Trade Commission vs. Raladam Co., decided May 25, 1931, in which the Supreme Court of the United States has apparently held that in order for a practice to constitute an unfair method of competition it must be shown to have the tendency to injuriously affect the business of competitors.

Hold Inter-Quarry Competitions

(*Continued from page 66*)

Although the day was overcast and a steady drizzle persisted during most of the afternoon, a large number of motor coaches, filled to capacity, brought parties from all parts of the county to witness the events and to cheer the competitors in their efforts.

A large crowd witnessed the drilling competition. Teams, consisting of a driller and his mate, were lined up and, at a given signal, advanced to the area of rock allotted to them, set up their drills and

The drilling competition in progress.

continued to drill until signaled to cease. The time allowed was half-an-hour from start to finish. After all the 18 competing teams—in 3 batches of 4 teams and 2 batches of 3—had finished drilling, E. A. Squirrell, J. P., chairman of the Roads and Bridges Committee of the Leicester County Council, assisted by W. Bennett, president of the National Union of Quarryworkers, measured the depth of the holes. The challenge cup, presented by P. L. Preston of the Cliffe Hill Granite Co., and the first prize were won by the Cliffe Hill Granite Co. "D" team with a hole measuring 12 ft. 7 in. The second prize, won by the Croft Granite Brick & Concrete Co., was awarded for a hole measuring 11 ft. 4 in. The third prize was won by the Cliffe Hill Granite Co. "C" team for a hole measuring 9 ft. 9 in., and the fourth prize by the Whitwick Granite Co. "A" team for a hole measuring 9 ft. 6 in.

A Correction

In the first paragraph, on page 58, of an article in the July 29, 1931, issue of PIT AND QUARRY describing the operations of Trent Concrete Co., Ltd., Colwick, England, the impression was inadvertently created that the new crushing equipment to be installed at the company's new gravel plant at Newark was to be of the Symons type. The Kennedy-Van Saun Mfg. & Engr. Corp. of New York, manufacturer of the Kennedy crusher in use at the company's Colwick plant, reports that the new crushing equipment obtained for the Newark plant was of Kennedy manufacture. The paragraph in question, in neglecting to mention the name of the machine to be installed, created some misunderstanding as to the type of machine that would be used.

MEN OF THE INDUSTRY

The portrait printed on this page in each number of PIT AND QUARRY is selected without significance as to current events or the position of the individual in the industry.

Photo by Blank-Stoller, Inc.

J. C. BUCKBEE
President
Northern Gravel Co.
West Bend, Wis.

Coming Events

Dec. 10, 1931. St. Louis, Mo. Monthly meeting, St. Louis Quarrymen's Assn., Forest Park Hotel. E. J. McMahon, exec. sec., 4063 Forest Park Blvd., St. Louis, Mo.

Jan. 9-15, 1932. Detroit, Mich. Annual Convention and show, American Road Builders' Assn. Chas. M. Upham, engineer-director, National Press Bldg., Washington, D. C.

Jan. 19-22, 1932. Pittsburgh, Pa. Annual Convention, National Crushed Stone Assn., Wm. Penn Hotel. J. R. Boyd, secretary, Merchandise Bldg., Washington, D. C.

Jan. 25-26, 1932. Pittsburgh, Pa. Annual convention, National Ready-Mixed Concrete Assn., Wm. Penn Hotel. V. P. Ahearn, executive secretary, Munsey Bldg., Washington, D. C.

Jan. 27-29, 1932. Pittsburgh, Pa. Annual convention, National Sand & Gravel Assn., Wm. Penn Hotel. V. P. Ahearn, executive secretary, Munsey Bldg., Washington, D. C.

Feb. 3-4, 1932. Washington, D. C. Annual meeting, Sand-Lime Brick Assn. Ellen Knight, sec., 321 N. Hamilton St., Saginaw, Mich.

Feb. 23-26, 1932, Wichita, Kan. Seventh Annual Southwest Road Show and School.

Feb. 23-26, 1932. Washington, D. C. Annual convention, American Concrete Institute, Wardman Park Hotel. Harvey Whipple, sec., 2970 West Grand Blvd., Detroit, Mich.

Pumpings from the Old Pit

Excerpts from the old files of PIT AND QUARRY *reveal many interesting sidelights on the activities of the pits, quarries and plants of former days. These are printed in this column each issue.*

Fifteen Years Ago

ORGANIZATION was announced of the Samfordyce Gravel Co. of Samfordyce, Tex. The company had a capitalization of $15,000 and planned to develop gravel deposits in that vicinity. Incorporators were Henry Klossner, A. J. Ross and Calvin V. Lysinger. Main offices of the company were established at Edinburgh, Tex.

* * *

A short editorial stressed the importance to every producer of having an accurate analysis made of his material so as to assure its fitness for quality concrete work.

* * *

Ten Years Ago

THE United States Gypsum Co., according to reports, was planning the erection of a retarder plant in connection with its extensive operations at Genoa, O.

* * *

Contracts were let by the Illinois State Department of Public Works for 95 miles of concrete road. The cost of the proposed work averaged $27,359 per mile. All the pavement was to be 18 ft. wide.

* * *

The Vulcanite Portland Cement Co. of Alpha, N. J., reduced the wages of its salaried employees 20 per cent., while the scale for laborers was cut from 27½ to 25 cents an hour. About 400 workers were affected.

* * *

C. A. Wallerstead, president of the Atlas Portland Cement Co., presided at the organization meeting of the Atlas Engineering Society composed of heads of the mechanical departments of the company. Regular meetings during the fall and winter were in prospect, with talks on various phases of plant operation scheduled for each meeting.

* * *

Operations were resumed at the Huntingdon, Pa., plant of the Columbia Sand Works after a shut-down of approximately a year. The Columbia company was a subsidiary of the Pennsylvania Glass Sand Co. of Lewistown, Pa.

* * *

Average cement prices for November, 1921, experienced a decline of 10 cents a barrel, changing from $3 retail to $2.90 delivered.

* * *

Five Years Ago

THROUGH the installation of numerous additional pieces of equipment, the Ottawa Silica Co. of Ottawa, Ill., producer of one of the widely-known brands of standard sand, doubled its capacity. Joseph Gyger was superintendent of the plant.

* * *

Importations of cement from Belgium and other European countries were beginning to become a serious menace to the American industry. Figures on imports for the first seven months of 1926 showed a total of 2,234,803 bbl., of which 1,567,250 bbl. were of Belgian manufacture.

* * *

The Missouri Valley Assn. of Sand and Gravel Producers, which included members from Missouri, Kansas and Oklahoma, was arranging for its annual meeting to be held Dec. 13 and 14, 1926, in Kansas City. Officers of the group were R. J. Stewart, president; N. C. Dunn, vice-president; F. W. Peck, secretary; and W. E. Johnson, treasurer.

* * *

Gabriel S. Brown, president of the Alpha Portland Cement Co., was elected president of the Portland Cement Assn. at the annual meeting held at the Drake Hotel, Chicago, Nov. 15-17, 1926. Other officers were E. M. Young, Lehigh Portland Cement Co., and Robert B. Henderson, Pacific Portland Cement Co., vice-presidents; and John W. Boardman, Huron Portland Cement Co., treasurer.

Road Builders Broadcast 126 Talks on Highways

Arrangements have been made by the American Road Builders' Assn. for the broadcast by radio of 126 addresses on matters pertaining to highways. These addresses are being made over 42 independent stations. Three talks will be made over each station as follows: Nov. 24, economy of good roads; Dec. 8, roadbuilding for unemployment relief. The first talk on highway safety was delivered on Nov. 10.

Silica-Sand Plant Fire Causes $100,000 Damage

Fire of undetermined origin caused damage estimated at $100,000 at the silica-sand plant operated by the Crescent Silica Sand Co. of Ottawa, Ill., on the night of October 25. The plant, largely of timber construction, was completely destroyed.

Book Review

ECONOMICS FOR ENGINEERS. *By Edison L. Bowers and R. Henry Rowntree. 312 pages. McGraw-Hill Book Co., New York, N. Y. Price $3.00.* Presents a general analysis and interpretation of the economic system from the point of view of the engineer. The volume differs from the usual economics text book in three respects:

1. Treatment of the subject is very concise.

2. The important aspects of business activity, such as marketing, investments and insurance, are discussed.

3. Emphasis is directed toward the engineering aspects of economic theory and business activity. Accordingly, the discussion of such a topic as "value" is less extensive, of "costs" is more complete and of "pricing" is more practical than usual.

Thus, in *Economics for Engineers* the economic theory in the ordinary sense is subordinated to the broad purpose of describing, analyzing, interpreting and appraising the economic system as a producing machine.

Personal Mention

Harold Smith, employed in the Armbrust Crushed Stone Quarry near Washington Courthouse, O., suffered a fractured arm and leg while at work recently. Mr. Smith fell and his arm and leg became caught in the tail pulley of a conveyor.

A. K. Humphreys of Alameda, Cal., has been appointed general manager of the Oakdale, Cal., crushed-stone plant of the Atlas Rock Co. of Los Angeles. He succeeds H. G. McMillan who recently disposed of his interests in the plant.

H. Joseph Hoffmann has been named secretary and treasurer of the Polysius Corp. with offices in the Bethlehem Trust Bldg., Bethlehem, Pa.

C. F. Herrington, well known in combustion-engineering circles, has been named sales engineer by the Grindle Fuel Equipment Co. of Harvey, Ill., a subsidiary of the Whiting Corp. Mr. Herrington has had 28 years' experience in engineering work. During the last nine years he has been affiliated with Heyl & Patterson, Inc., of Pittsburgh, Pa., where he had charge of engineering, selling and erection of pulverized-coal plants such as those installed by the Erie Malleable Iron Co., the Raritan Copper Works, at Perth Amboy, N. J., the smelter of the International Nickel Co. of Canada, also equipment for the smelters of the Union Minerre du Haut Katauga in Africa and the Nouvelle Foundry in Belgium.

Clinton Johnson was severely injured on October 15 while at work in the sand-and-gravel plant operated by Fred A. Rider, Inc., at Willow Point, N. Y.

W. S. Brimijohn, formerly superintendent of the Hercules Powder Co. explosives plant in Emporium, Pa., has joined the safety and service department of the home office in Wilmington, Del., where he will study the elimination of explosive hazards throughout the company's plants. His connection with the Hercules Powder Co. began in 1914, but he has been in the explosives industry since 1906.

Horace Bowker, president of the American Agricultural Chemical Co., has been appointed a divisional chairman of the commerce and industry division of the Emergency Unemployment Relief Committee. Mr. Bowker will be at the head of the division's activities in the chemical trades.

Harry S. Sleicher, formerly vice-president of the North American Refractories Co., has severed his connection with that company and is now associated with the General Refractories Co. in a sales capacity, with headquarters in the New York office of the latter company.

Thos. J. Harte.

Thomas J. Harte has been elected vice-president and general sales manager of the North American Cement Corp., Albany, N. Y., succeeding Frederick A. Boeye whose death occurred October 3. Mr. Harte had been associated with Mr. Boeye since the formation of the concern in training and handling the company's sales organization. He is well known throughout the cement industry.

Ralph Leavenworth has been appointed general advertising manager of the Westinghouse Electric & Manufacturing Co., according to an announcement by **J. S. Tritle,** vice-president and general manager. He will have charge of all advertising and publicity activities of the company, including the advertising division of the merchandising department, now centered in Mansfield, O. Graduating from Hamilton College, Clinton, N. Y., in 1914, Mr. Leavenworth became associated with the Y. M. C. A. After the war he joined the Standard Parts Co. of Cleveland, and except for a short period, he was advertising manager of this concern until 1923. In that year he became an account executive for Paul Teas, Inc., an industrial advertising agency. He remained with this firm six years becoming in that time part owner of the company. On January 1, 1930 he joined the Austin Co., of Cleveland, one of the world's largest engineering and building organizations, as assistant general sales manager. In this work he served in an executive capacity on sales, administrative and advertising work concerned with this international organization. His appointment as general advertising manager of the Westinghouse company followed. He will have his office at East Pittsburgh.

Ralph Leavenworth.

Ralph C. Johnson has been named sales manager of the Simplicity Engineering Co., at Durand, Mich. Previous to this connection, Mr. Johnson served as sales engineer with the Denver Equipment Co., at Denver, Colo., and with the Allis Chalmers Manufacturing Co. in the mining department at Milwaukee. He was graduated from the University of Minnesota in 1922 with a mining engineering degree, after which he joined the operating staff of the Mesabi Iron Co. at Babbitt, Minn.

Obituary

Herbert Schatzel, 20, employed in the gravel pit operated by his father, Frank Schatzel, at Pisgah, O., met death by suffocation recently in a cave-in while at work in the pit.

Robert M. Thacker, 70, superintendent of the Southwestern Stone Co. plant near McAlester, Okla., died suddenly of heart disease recently. He is survived by the widow and three children.

Philip A. Koehring, president of the National Equipment Corp. of Milwaukee, Wis., manufacturer of much of the machinery used in the nonmetallic-mineral industries, was found dead from a gunshot wound in his automobile near Mauston, Wis., on October 31. A rifle lay in his lap when the body was discovered. Mr. Koehring was *en route* from Minneapolis to his home in Milwaukee. Authorities are undecided whether his death was suicide, murder or accidental.

Financial News

The information contained in these financial pages is given with the understanding that any statement on the part of this magazine or any of its staff, as to the responsibility or standing of any person, firm or corporation, or as to the value of any property or securities is a mere expression of opinion, given as a matter of service to the readers of PIT AND QUARRY, *for which no responsibility in any way is to attach to this magazine or to any of its staff.*

New Building Projects Aid Canada Cement Co.

For the fiscal year ending November 30, 1931, Canada Cement Co. will show the preferred dividend safely earned, and a balance applicable to the common stock. Preferred dividends this year will approximate the $1,363,732 so required in 1930.

This company, handling approximately four-fifths of the Dominion's cement business, would benefit greatly for a considerable period from work in the near future on the huge St. Lawrence seaway project as now contemplated, and being discussed by officials of Canada and the United States.

Business now in sight indicates another profitable period in the 1931 fiscal year. Unemployment relief work, which is planned on a comprehensive scale all over the Dominion, will result in considerable business for the company. The all-Canada highway, which is likely to become a fact before long, would require 37,500,000 bbl. of cement. Important building projects, including construction of a new post office at Montreal and other public and private buildings, are planned for the next year. Recent order suspending work on the new Canadian National terminal at Montreal, which work, now only partly completed, called for a total of 350,000 bags of cement is stated to be only a temporary halt on this work.

Report of company for the fiscal year ended November 30, 1930, showed net income, after all charges including interest and provision for depreciation, reserves, etc., of $1,566,014, equal after preferred dividends to 34 cents a share on 600,000 shares of no-par common.

Texas Gulf Sulphur to Earn About $3 per Share

Earnings of the Texas Gulf Sulphur Co. in the final quarter probably will equal at least the 76 cents a share earned in the second quarter, when income was the lowest for any period this year. Net in the first nine months of 1931 was $6,704,091, or $2.64 a share on 2,540,000 shares. Thus, net for the full year should be in the neighborhood of $3.40 a share, against $5.50 a share earned in 1930. The current $3 dividend requirements accordingly will be covered by a comfortable margin.

Texas Gulf's net in the third quarter was $2,315,926, or 91 cents a share on 2,540,000 shares, against $1,939,967, or 76 cents a share, in the second quarter, and $2,448,198, or 96 cents a share, in the first quarter. The increase shown in the third quarter was due almost entirely to increased shipments against contracts and does not mean that there has been a corresponding increase in business booked. The volume of sulphur sales this year is off about 40 per cent. from the peak 1929 level.

Cash in banks is in excess of $3,000,000, about the same as was on hand six months ago. Texas Gulf has been accumulating inventories of sulphur above ground for some years as a reserve supply. There is now on hand at the deposits of New Gulf, Long Point, and Gulf in excess of 2 000,000 tons carried in the balance sheet at cost. This is sufficient for at least two years' business under current conditions.

As part of the program of economy, a larger share of current shipments will be drawn from reserves, making it possible to curtail new production. This obviously will improve the company's cash position, since the sulphur in inventory has been charged against operating expenses of prior years. Inventories of sulphur above ground at the end of 1930 were carried at $11,928,750. Including sulphur at current market value, net current assets would appear to be equal to about $17 a share on the stock. There is some basis, too, for the belief that the low point in the consumption of sulphur and sulphuric acid has been reached.

Penn-Dixie Has Loss in Twelve-Months' Period

Pennsylvania-Dixie Cement Corp. and subsidiaries report for the 12 months ended September 30, 1931, profit of $895,392 before depreciation, depletion, federal taxes and interest. After providing for interest and federal taxes, profit before depreciation and depletion was $238,737, and net loss after depreciation and depletion amounted to $1,149,688. This compares with net profit in the preceding 12 months of $417,192, equal to $3.07 a share on 135,888 shares of 7 per cent. preferred stock.

Cash and short-term securities amounting to $3,155,842 are greater than a year ago and more than eight times current liabilities.

Consolidated income account for 12 months ended September 30, 1931, compares as follows:

	1931	1930
Operating profit	$895,392	$2,552,762
Depreciation & depl.	1,388,425	1,386,517
Loss	$493,033	*$1,166,245
Interest	637,209	681,369
Federal taxes	19,446	67,684
Net loss	$1,149,688	†$417,192

*Profit. †Net profit.

Consolidated balance sheet as of September 30, 1931, compares as follows:

ASSETS

	1931	1930
*Ld. bldgs., eqpt., etc.	$23,345,854	$24,601,339
Cash	2,785,842	2,813 902
Notes and accts. rec.	734,024	1,065,113
Inventories	2,337,889	2,699,586
Short-term secur.	370,000	.....
Miscellaneous invest.	340,721	402,918
Assets with trustee	510	.....
Insur. fd. & emp. stock	195,261	158,950
Deferred charges	23,087	11,818
Total	$30,133,188	$31,753,626

LIABILITIES

Preferred stock	$13,588,800	$13,588,800
†Common stock	4,000,000	4,000,000
Gold bonds	10,281,000	10,929,000
Accounts pay.	160,442	205,242
Accrd. tax, int., etc.	148,018	185,304
Federal tax res.	48,898	165,586
Miscellaneous res.	376,936	249,588
Surplus	1,529,094	2,430,106
Total	$30,133,188	$31,753,626

*After depreciation and depletion. †Represented by 400,000 no-par shares.

CURRENT DIVIDENDS

Company	Class of Stock	Dividend Rate	Holders of Record	Payable
Arundel Corp.	Common	$0.75 qr.	Sept. 21	Oct. 1
Boston Sand & Gravel	Common	$0.15 qr.	Sept. 22	Oct. 1
Boston Sand & Gravel	Preferred	$0.87½ qr.	Sept. 22	Oct. 1
Calaveras Cement	Preferred	$1.75 qr.	.....	Oct. 15
Cleveland Quarries Co.	Common	$0 25 qr.	Nov. 10	Dec. 1
Consolidated Oka Sand & Gravel	Preferred	$1.75 qr.	Sept. 25	Oct. 1
Dolese & Shepard	Common	$1.00 qr.	.....	Oct. 1
Dufferin Pav. & Crushed Stone	Preferred	$1.75 qr.	.....	Oct. 1
Giant Portland Cement	Preferred	$1.75 S.A.		Dec. 15
Ideal Cement	Common	$0.50 qr.	Sept. 15	Oct. 1
International Salt	Common	$0.75 qr.	Sept. 15	Oct. 1
Johns-Manville	Common	$0.75 qr.	.....	Oct. 15
Johns-Manville	Preferred	$1.75 qr.	.....	Oct. 1
Kelley Island Lime & T.	Common	$0.50 qr.	Sept. 24	Oct. 1
Lehigh Portland Cement	Preferred	$1.75 qr.	Sept. 14	Oct. 1
Missouri Portland Cement	Common	$0.25 qr.	Oct. 22	Oct. 31
National Gypsum Co.	Preferred	$1.75 qr.	Sept. 15	Oct. 1
Pacific Portland Cement	Preferred	$1.62½ qr.	Sept. 30	Oct. 5
Pennsylvania Glass Sand	Preferred	$1.75 qr.	Sept. 15	Oct. 1
Pittsburgh Plate Glass	Common	$0.50 qr.	Sept. 10	Oct. 1
Port Huron Sulphur	Common	$0.15 qr.	Oct. 15	Nov. 1
Raymond Concrete Pile	Preferred	$0.75 qr.	Oct. 20	Nov. 1
Riverside Cement	1st Pfd.	$1.50 qr.	Oct. 15	Nov. 1
Santa Cruz Portland Cement	Common	$1.00 qr.	.....	Oct. 1
Schumacher Wallboard	Preferred	$0.50 qr.	Nov. 5	Nov. 15
Superior Portland Cement	Class A	$0.27½M	Nov. 23	Dec. 1
Warner Co.	Common	$0.25 qr.	Sept. 30	Oct. 15
Warner Co.	1st Pfd.	$1.75 qr.	Sept. 15	Oct. 1
Warner Co.	2nd Pfd.	$1.75 qr.	Sept. 15	Oct. 1

Recent Patents

AMERICAN

Blasting

Blasting cartridge. Frank H. Armstrong, Chicago, Ill., assignor to Safety Mining Co., same place. No. 1,826,702.

Blasting cartridge. Frank H. Kneeland, Chicago, Ill., assignor to Safety Mining Co., same place. No. 1,827,318.

Cement and Concrete

Concrete-transporting apparatus. James P. Gillespie, New York, N. Y. No. 1,828,181.

Method and apparatus for burning Portland cement. Evald Anderson, Alhambra, Cal., assignor to International Precipitation Co., same place. No. 1,828,270.

Means for transporting concrete. Carl G. A. Schmidt, Jr., Kennett Square, Pa., assignor to American Road Machinery Co., same place. No. 1,828,343.

Apparatus for making cement. Henry Vanderwerp, Manitowoc, Wis., assignor to Rotary Pressure Cooler Co., same place. No. 1,826,847.

Method of treating foam compounds for use in making cellular concrete. John A. Rice, Berkeley, Cal., assignor to Bubblestone Co., Pittsburgh, Pa. No. 1,826,897.

Kiln for the production of cement. Hans Engel, Stettin, Germany. No. 1,827,144.

Means for charging concrete mixing or transporting vessels. Joseph Eggert, Columbus, O., assignor to Jaeger Machine Co., same place. No. 1,827,713.

Crushing and Grinding

Grinding mill. Richard S. Iglehart, Springfield, O., assignor to Bauer Bros. Co., same place. No. 1,827,986.

Hammer-mill. Walter J. Clement, New Hartford, N. Y., assignor to Bossert Corp., Utica, N. Y. No. 1,828,490.

Excavating

Mechanical shovel. Roy M. Baker, Chisholm, Minn. No. 1,828,095.

Excavating shovel. Herman J. Brendlin, New York, N. Y., assignor to Hayward Co., same place. No. 1,826,920.

Excavator Accessories

Dipper-door latch release. Lagar R. Culver, Los Angeles, Cal. No. 1,827,420.

Boom construction far paving machines. Philip A. Koehring, Milwaukee, Wis., assignor to Koehring Co., same place. No. 1,827,527.

FOREIGN

Blasting

Percussion caps and the like. H. W. Brownsdon and Imperial Chemical Industries, Ltd. British 356.765.

Explosive compositions. Dr. A. Stettbacher. British 356,772.

Cement and Concrete

Producing magnesian Portland cements. E. Boyneburg. British 355,678.

Manufacture of concrete. K. Winkler. British 355,902.

Hydraulic cements and the like. Dr. K. Biehl. British 356,144.

Process and apparatus for manufacturing cement. Miag Mühlenbau und Industrie Akt.-Ges. British 356,611.

Process for production of cement. Bruderus'sche Eisenwerke and Waldemar Paulsen, Wetzlar. German 536,711.

Crushing and Grinding

Centrifugal grinding mill with vertical shaft and with air separation. Adolf Steinbrückner, Duisburg-Wanheimerort, Germany. German 536,229.

Stone crusher. Joseph Vögele Akt.-Ges., Mannheim. German 536,502.

Hammer mill. Fried. Krupp Grusonwerk Akt.-Ges., Magdeburg-Buckau. German 536,692.

Drilling

Front head for pneumatic percussive tools. Ingersoll-Rand Co. British 356,009.

Rock drills, cutting picks and other hard metal tools. F. Krupp Akt.-Ges. British 356,029.

Valve apparatus for rock drills and like fluid-pressure operated tools. G. H. T. Rayner and P. T. Rayner. British 356,438.

Feeding-device for rock drills. Ingersoll-Rand Co. British 356,543.

Rock drills and like implements. H. E. Warsop. British 356,572.

Rock drills. B. Roberts, F. C. Banwell and R. Bowden. British 356,588.

Pneumatically-actuated percussive tools. Reavell & Co., Ltd., and P. C. Bird. British 356,930.

Links for use in well-drilling apparatus. A. E. White (Acme Fishing Tool Co.) British 356,976.

Feeding-devices for percussive tools. Ingersoll-Rand Co. British 356,989.

Drying

Drying apparatus. A. G. Murdoch. British 355,685.

Apparatus for drying sand. Johann Kuhnen, Coblenz. German 536,973.

Excavating

Drag scraper bucket. Adolf Bleichert & Co., Akt.-Ges., Leipzig. German 536,354.

Kilns

Ring-grate installed ahead of rotary kiln for preheating or pre-calcining cement raw mix. Georg Neumann, Hagen i. W., Germany. German 535,820.

Gas-removal apparatus for rotary kilns. Arno Andreas, Münster i. W. German 536,875.

End of rotary kiln for discharge of burnt gas. Arno Andreas, Münster i. W. German 536,876.

Material-Handling

Conveyors. E. E. Curtis. British 356,148.

Conveyor mechanism. A. E. White (Morgan Construction Co.) British 356,648.

Portable car dumper. Fried. Krupp Grusonwerk Akt.-Ges., Magdeburg-Buckau. German 535,822.

Sand elevator. Charles B. Thompson, Seattle, Wash. Canadian 316,279.

Mixing

Concrete-mixing machines and the like. H. Langford and Winget, Ltd. British 356,558.

Mixing-apparatus. P. Lenart. British 356,608.

Screening and Separating

Vibrating-mechanism for screens. U. S. James. British 355,824.

Separation of intermixed divided materials. A. E. White (R. Peale, W. S. Davies and W. B. Oakes). British 355,313.

Shaker sieves and the like. R. Herrmann. British 355,554.

Dust separator. Ernst Curt Loesche, Berlin-Lanwitz, Germany. German 535,238.

Process for separating the heavier and larger particles from a current of dust and air. Societe Anonyme des Appareils de Manutention et Fours Stein, Paris. German 535,312.

Gravity separator for pulverulent materials. Dipl.-Ing. Ernst Heilmann, Kaiserslautern. German 535,313.

Device for separating material from a current of air. Ernst Curt Loesche, Berlin-Lankwitz. German 535,314.

Centrifugal dust separator. Maschinenfabrik Augsburg-Nürnberg Akt.-Ges., Nürnberg. German 535,315.

Washing

Rotary apparatus for washing gravel, sand, and other materials. T. A. Pool. British 356,913.

Unclassified

Conduits for conveying pulverized fuel and air or gas to furnaces. E. Hermsdorf. British 355,976.

Process of extracting the impurities from quartz, silicates, and particularly from clay. W. W. Triggs (Soc. des Produits Chimiques Alterra Soc. Anon.) British 356,145.

Method of leaching phosphate rock. Kunstdünger - Patent - Verwertungs Akt.-Ges. British 356,627.

(Continued on page 75)

PIT AND QUARRY *will furnish, at its actual cost, a copy of any patent cited here. A charge of ten cents per copy is made by the U. S. Patent Office, Washington, D. C., and readers may procure a copy directly by addressing the Commissioner of Patents, with payment for copies requested. Postage stamps are not accepted by the Patent Office. We will endeavor to obtain copies of foreign patents for our readers but we cannot give assurance in every case for the reason that copies of such patents are not printed for distribution as liberally as are the American copies, nor is there a fixed charge per copy.*

Traffic News and Comment

Examiner's Reports

Sand.—Examiner C. Garofalo recommends that the commission find the interstate rates on sand from Polk, Pa., to Coraopolis and Kendall, Pa., unreasonable to the extent that they exceeded $1.20, and the rates to Glassport and Homestead, Pa., unreasonable to the extent that they exceeded $1.30, and award reparation in I.C.C. Docket No. 24,144, Continental Roll & Steel Foundry Co. *et al. v.* N.Y.C. *et al.* He further recommends that the commission find the rate on the same commodity from Polk to Erie, Pa., was, is and for the future will be unreasonable to the extent that it exceeded, exceeds or may exceed $1.10, and award reparation in I.C.C. Docket No. 24,291, National-Erie Co. *v.* N.Y.C.

New Complaints Filed

Cement.—Violation of Sec. 1 and 6 is alleged and new rates and reparation sought on cement, between North Birmingham, Ala., and points in Connecticut, Delaware, District of Columbia, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin, in I.C.C. Docket No. 24,717, Southern Cement Co., Birmingham, Ala. *v.* A. G. S. *et al.*

Complainant alleges violation of Sec. 1 and 15 and seeks reparation on cement rates from Dewey, Okla., to points in Texas I.C.C. Docket No. 24,728, Dewey Portland Cement Co., Kansas City, Mo. *v.* A. T. & S. F. *et al.*

Crushed Stone.—Rates on crushed stone from Marquette, Mo., to Memphis, Tenn., are alleged to be in violation of the sixth section and reparation is sought in I.C.C. Docket No. 24,710, Gauger-Korsmo Construction Co., Memphis, Tenn. *v.* M. P. *et al.*

Because arbitrary mileage is assessed for the crossing of Susquehanna River in the case of traffic originating at Campbell, Pa., while from Union Stone, Pa., such mileage is not assessed, reparation is sought on the allegation that the rates are in violation of Sec. 1, 2 and 3, quarries at Union Stone and Bainbridge, Pa., being preferred. I.C.C. Docket No. 24,736, York Valley Lime & Stone Co., Inc., York, Pa. *v.* P.R.R.

Empty Returned Cement Bags.—Reparation is asked for on an allegation of rates in violation of Sec. 1 and 6 on empty returned cement bags to Davenport, Ia., from various points of origin in I.C.C. Docket No. 24,727, Dewey Portland Cement Co., Kansas City, Mo. *v.* C. R. I. & P.

Ground Limestone.—A complaint of unreasonable rates on crushed, ground, granulated, precipitated and/or pulverized limestone from Lime Crest, N. J., to points in official classification territory has been filed with the Commission, and new rates and reparation sought. I.C.C. 24,757, Limestone Products Corp. of America, Newton, N. J. *v.* A. T. & S. F. *et al.*

Rate-Committee Dockets

Trunk Line Assn.

Cement.—Shippers propose a rate of 10.5 c. per 100 lb. on cement, car-load minimum weight 50,000 lb., from Alsen, N. Y., to West Haverstraw, N. Y. The proposed rate is 114 per cent. of the 12,710 scale.—Docket No. 27,876.

Crushed Stone.—Carriers propose to publish the same rates on crushed stone[1], from Munns, N. Y., to stations on the D. & H. as are now in effect from Oriskany Falls, N. Y., to the same destinations.—Docket No. 27,888.

Crushed Stone and Ground Limestone.—Shippers at Blakeslee and Jamesville, N. Y., propose a revision in the rates on crushed stone[1], and ground limestone car-load minimum weight 60,000 lb., to destinations on the D. L. & W. and the L. V. A list of proposed rates will be furnished on request.—Docket No. 27,890.

To meet motor-truck competition carriers propose to publish a rate of 60 c. a net ton on crushed stone and stone dust (other than bituminous asphalt rock) in shipping containers loaded on container cars. Car-load minimum weight 110,000 lb.—Docket No. 27,898.

Lime.—Shippers at Dover Plains, N. Y., are proposing a line of rates on building, agricultural and chemical lime, car-load minimum weight 40,000 lb., to destinations in trunk-line territory which they claim are comparable with the rates in effect from Cheshire, Mass., and Canaan, Conn. A complete list of proposed rates will be furnished on request.—Docket No. 27,907.

Roasted Dolomite.—Carriers propose to establish a rate on roasted dolomite from Millville, Williams and Blue Bell, W. Va., to Buffalo, N. Y., of $2.24 a net ton.—Docket No. M-1,886.

Sand.—To meet motor-truck competition shippers propose a reduction in the rate on sand[1], from Menantico, N. J., to Bridgeton, N. J.—Docket No. 27,878.

Sand and Gravel.—To meet motor-truck competition carriers propose to reduce the rate on sand and gravel[1], from Morristown, N. J., to Summit, N. J., from 50 c. to 35 c. a net ton.—Docket No. M-1,891.

Slag.—Shippers propose the establishment of a commodity rate of $1.25 a net ton on crude or crushed slag[1], from Sparrows Point, Md., to Falls Church, Va.—Docket No. 27,862.

Central Freight Assn.

Cement.—Carriers propose to establish a through commodity rate on cement, car-load minimum weight 50,000 lb., from Fultonham, O., to West Jefferson, O., of 11 c. per 100 lb. The combination rate of 18½ c. now applies.—Docket No. 29,647.

Crushed Stone.—Marblehead, O., shippers propose the publication of commodity rates on crushed stone and crushed-stone screenings to A.A.R.R. stations: Clare, Mich., $1.65; Rosebush, Mich.; $1.55; and P.M.R.R. stations: Alment, Mich., $1.95; Memphis, Mich., $1.85; and Weidman, Mich., $1.75.—Docket No. 29,549.

Shippers at Shimer, O., propose the establishment of commodity rates on crushed stone to representative points in West Virginia, viz., Charleston, $1.25; Huntington, $1.20; Ranger and Ferrell, $1.30; Omar, Argonne, Holden, Rum Junction, Amherstdale, Hetzel, Huff Junction, Seth, Red Dragon, Madison, Five Block and Red Warrior, $1.50; Emmett and Edwight, $1.60; Ridgeview and Fork Jct., $1.40. Class rates now apply.—Docket No. 29,584.

Dolomite.—Narlo, O., shippers propose the establishment of through commodity rates on roasted dolomite[1]; to Atlanta, Ga., $4.47; Alabama City, $4.56; and Birmingham, Ala., $4.88 per net ton.—Docket No. 29,589.

Fluorspar.—Carriers propose to establish on fluorspar in packages or in bulk, car-load minimum weight 40,000 lb., to Sault Ste. Marie, Ont., from Evansville, Ind., and points taking same rates, a rate of $6.95, and from Owensboro, Ky., a rate of $7.95 per net ton. This cancels Docket No. 29,494.—Docket No. 29,559.

Fluxing Stone.—Shippers propose the establishment of a commodity rate of $1.10 a gross ton on fluxing limestone[1], from Annandale, Branchton, Harrisville and Osbornes, Pa., to Vandergrift, Pa. The sixth-class rate now applies.—Docket No. 29,548.

Gypsum Products.—Carriers propose to cancel the rate of 13 c., car-load minimum weight 40,000 lb., on gypsum blocks or tile; gypsum rock, run-of-mine, crushed, not ground; gypsum rock, ground (land plaster); plaster-board; plaster calcine (stucco, plaster of Paris); wall plaster; lime (hydrate, quick or slaked), included with shipments of plaster, quantity not to exceed 25 per cent. of minimum car-load weight governing such shipments, nails, etc., applying in connection with the M. St. P. &. S. S. M., from Grand Rapids, Granville, Eagle Mills (Kent Co.) and Wentworth, Mich., to Manitowoc, Wis., as named in C.F.A. Tariff 367-E, p. 63.—Docket No. 29,550.

Lime.—Carriers propose to establish commodity rates on (a) common

lime, and on (b) agricultural lime, carload minimum weight 30,000 lb., from Alsace, Pa., to N. Y. C. R. R. stations. Proposed rates to representative destinations in cents per 100 lb., in Docket No. 29,558, are:

To—	(a)	(b)
Ashtabula, O.	12 c.	9.5c.
Dorset, O.	11.5c	9 c.
Simons, O.	11 c.	9 c.
Salem, Pa.	10.5c.	8.5c.
Sandy Lake, Pa.	10 c.	8 c.
Franklin, Pa.	9.5c.	7.5c.
Oil City, Pa.	10 c.	8 c.
Youngstown, O.	12.5c.	10 c.
Sharon, Pa.	12.5c.	10 c.
Erie, Pa.	13 c.	10 c.
Stanhope, O.	11.5c.	9 c.

Carriers propose to revise the rates on carbonate of lime (recarbonated waste), in packages or in bulk, carload minimum weight 50,000 lb., in cents per 100 lb., from Painesville, O., and Barberton, O., as shown below.—Docket No. 29,644.

To—	Present Painesville	Proposed Painesville	Present Barberton	Proposed Barberton
Bedford, O.	7.5c.	8 c.	6 c.	7.5c.
Jeanette, Pa.	10 c.	10.5c.	10 c.	10.5c.
Wash., Pa.	10 c.	10.5c.	10 c.	10.5c.
Ashtabula, O.			8.5c.	9 c.
Canton, O.			6 c.	7.5c.
Elyria, O.			7 c.	8 c.
Mansfield, O.			8 c.	8.5c.
Willoughby, O.			8 c.	8.5c.

Sand and Gravel.—Shippers propose a reduction in the rate on sand and gravel from Hugo, O., to Concord, O., from $1.00 to 90 c. a net ton, to route via N.Y.C., Painesville, O., B. & O.—Docket No. 29,547.

A reduction in the rates on common sand and gravel from Sandusky, O., to Marblehead, O., from 70 c. to 60 c. a net ton.—Docket No. 29,639.

Shippers of common sand and gravel at Ashtabula and Ashtabula Harbor, O., are asking that the rate to Jamestown, Pa., and Simonds, O., be reduced from 90 c. to 70 c. a net ton.—Docket No. 29,645.

Carriers propose to establish on common sand and gravel, from Winina Lake and Warsaw, Ind., to Bippus, Bolivar, Disko, Huntington, Laketon and Servia, Ind., a rate of 70 c. a net ton, a reduction of 18 c. to the first three stations and 10 c. to the others.—Docket No. 29,646.

Illinois Freight Assn.

Sand and Gravel.—Revisions of the rates on sand and gravel from Worth, Ill., are proposed as follows in Docket No. 6,317:

To—	Present	Proposed
Lodge, Ill.	$1.01	$0.88
Taylorville, Ill.	1.39	1.13
Clarksdale, Ill.	1.39	1.13
Palmer, Ill.	1.39	1.13
Morrisonville, Ill.	1.39	1.13
Harvel, Ill.	1.39	1.13
Raymond, Ill.	1.39	1.13

Southern Freight Assn.

Mica Schist.—It is proposed by shippers to establish the following rates on mica schist, dry ground and/or screened, car-load minimum weight 60,000 lb., from Franklin, N.C., in Docket No. 55,787, rates per net ton:

To—	Proposed
Cincinnati (proper), O.	$4.68
Cincinnati (for beyond)	4.12
Louisville (proper), Ky.	4.68
Louisville (for beyond)	4.12
New Albany (proper), Ind.	4.68
New Albany (for beyond)	4.12
E. St. Louis, Ill.	7.00
St. Louis, Mo.	7.00
Chicago, Ill.	6.77
Cleveland, O.	6.39
Franklin, O.	5.25
Joliet, Ill.	6.77
South Bend, Ind.	6.51
Baltimore, Md.	5.21
Bound Brook, N. J.	6.41
Erie, Pa.	7.40
Fulton, N. Y.	7.96
Millis, Mass.	8.21
York, Pa.	6.16

Southwestern Freight Bureau

Asphalt Rock.—Carriers propose to establish commodity rates on asphaltic rock[1], from Dougherty, Okla., to points in Kansas, Missouri, Nebraska (including the Missouri River cities), and destinations in Western Trunk Line territory east of Missouri River, based on the distance schedule of rates as prescribed by the Interstate Commerce Commission in Docket No. 23,094, after having extended the scale beyond 800 mi. to 1,000 mi. at the same rate of progression as the last block of the scale, *i.e.*, at 10 c. for each 30 mi.—Docket No. 23,591.

Asphaltic Limestone. — Shippers propose the amendment of Item 20. S.W.L. Tariff 99-A, applying on limestone from Cherokee and Margerum, Ala., to Arkansas, Kansas, Louisiana, Missouri, Oklahoma and Texas, by adding the following paragraph as an additional application: "Asphaltic limestone, broken, crushed or ground, containing not more than 5 per cent. artificially-added asphalt[1]." The rates published from Margerum and Cherokee, Ala., into the Southwest are limited so they may not be applied on the ready-to-lay article. The Southwestern Lines, however, have published a description which includes asphalt rock, a ready-to-lay article. In view of the fact that the scale from the Southwest applies on the ready-to-lay article as well as the article to which some ingredients have been added, the producers at the Alabama points are preparing to treat the natural article so that they may be in a position to ship a ready-to-lay material. The ready-to-lay material from Texas is a higher-grade article. It is the opinion of shippers at Cherokee and Margerum, Ala., that, since the Southwestern Lines may ship the crude material and the ready-to-lay material on the same basis of rates, they should be permitted to enjoy the same scale on the ready-to-lay article as on the crude material.—Docket No. 23,577.

[1] The carload minimum weight will be 90 per cent. of the marked capacity of the car except that, when car is loaded to full cubical or visible capacity, actual weight will apply.

Recent Patents

(*Continued from page 73*)

Chocks and props for use in mines and the like. S. Walton-Brown. British 356,284.

Plaster for walls and the like. E. N. Craig and K. N. Craig. British 356,711.

Sectional barges and similar craft. R. MacGregor and MacGregor & King, Ltd. British 356,936.

Process of preparing absolute alcohol and commercially pure powdered hydrated lime. Merck & Co., Inc., assignee of Wm. Henry Engels, Rahway, N. J. Canadian 316,552.

Bag-filling machine. F. L. Smidth & Co., New York City, N. Y., assignee of Kristian Middelboe, Copenhagen, Denmark. Canadian 316,567.

Industrial treatment of leucite, or of aluminous potassic and sodic silicates, or of natural and artificial alums, for the purpose of obtaining pure alumina, compounds of potassium or sodium and silica. G. Gallo. British 354,255.

Metal arches for mines and the like. Brymbo Steel Co., Ltd., and L. Griffiths. British 354,230.

Process for the manufacture of bitumen-concrete mixtures and sand-bitumen mixtures. H. Milke and Dr. J. Oberbach. British 354,433.

Metal pit props. J. W. White. British 355,317.

State's Refusal to Use Stone May Close Plant

The Lockport Stone Co., Inc., of Lockport, N. Y., produces crushed stone from rock which was excavated when the New York State Barge Canal was constructed. Some time ago, this company was notified that the New York state highway commission had rejected its stone as being unsuitable for highway work. Not content with such an abrupt rejection, however, George R. Broderick, manager and superintendent, made further inquiries and was informed that the stone had been rejected because it had failed to pass the state's abrasion tests. In 1928, the state had ruled that the stone was acceptable for first-class concrete, so Mr. Broderick undertook to have an impartial test made of the material. The Pittsburgh Testing Laboratory, because of its recognized standing, was chosen and abrasion tests were made, using standard Deval closed-barrel abrasion apparatus, in accordance with A. S. T. M. specifications. The sample of stone under test weighed 5,000 grams before and lost but 260 grams in the test, or 5.2 per cent. Inasmuch as New York specifications permit up to 5.7 per cent. of wear for stone, the Laboratory put its stamp of approval on the material.

The Lockport company, however, has been unable to make any progress toward gaining acceptance of its material and is facing possible abandonment of its operations unless relief is forthcoming.

Review of Foreign Practice

Effect of Admixtures on Cements Made from Slag

Attempts to improve the quality and other properties of cement by means of admixtures have been numerous and, in part, successful. The investigations reported here were made at the Institut für Eisenhütten und Giessereiwesen of the Bergakademie Clausthal, to determine the influence of certain admixtures on the sintering temperature of the raw mix, the nature of the clinker microstructure and the technical properties of the clinker (burned in a crucible kiln) and of the cement made from it. The cement tested was produced from limestone and granulated basic slag, and the admixtures employed were fluorspar, calcined pyrites, potassium chloride, calcium chloride and sodium chloride. In each case admixtures of 0.3, 0.6, 0.9, 1.5 and 3.0 per cent. by weight were investigated. The results of the various tests (fully reported with tables and charts) indicate that admixtures up to 0.6 per cent. were favorable in every regard in their effect on the different properties of the raw mix and of the clinker and cement produced from it. The calcium-chloride admixture, in particular, gave in this investigation the most favorable effect; however, if the lime modulus is high, the lime content of the calcium chloride must be taken into account. The potassium chloride admixture was second best, so long as the proportion did not exceed 0.3 per cent. The cement with sodium chloride was of about the same quality, but again only up to 0.3 per cent. In the employment of fluorspar it must be observed that too high a proportion under certain conditions can effect a serious drop in strength; this is in accord with previously reported investigations. The poorest cement and at the same time the one most capable of improvement is that with the admixture of calcined pyrites. This material also shows up to 0.3 per cent. a tendency to increase strength; it should be possible to increase this tendency considerably in the case of higher proportions if the lime content were held to the original quantity.—Prof. Dr.-Ing. Max Paschke and Werner Meyer in *Zement* 20:850-854, Sept. 17, 1931.

Procedure Involved in Making Special Units

When the "special" or "high-test" cements (alumina cement, etc.) are used for the manufacture of concrete products, several special instructions must be observed that differ from the same handling of the customary Portland. For the production of concrete pipes, concrete tile or blocks the special cement must always be used only in "earth-moist" state, never wetter than with Portland, and particular care must be given to the thorough mixing of the cement and the aggregate. If this is observed the forms can be removed immediately after tamping. After the removal of the forms the products show a dark color approaching brown, which lightens after two or three hours in summer or five to six hours in the winter, indicating the beginning of curing. When this occurs, but not before, the products are thoroughly moistened by means of a watering-pot as long as the surface takes water. During the first 24 hours this should be repeated when the products show signs of drying, and two to four times the second day. The products are then thoroughly hardened and ready for market.

In the manufacture of paving or curb-stones the mix should be only slightly plastic, so that the mass "gives" under the blows in tamping. In smoothing after tamping, water should press to the surface in only slightly visible quantity. These products should then be moistened in the way described.—*Deutsche Kunststein- und Zementwaren-Zeitung* 4:270, Aug. 31, 1931.

High-Strength Lime Is Revealed by New Method

A process of producing hydraulic limes of remarkably high strength by "overburning" and "overslaking" limestones, which was developed several years ago and described in *Revue des Materiaux de Construction* for October, 1928, and January, 1929 (unfortunately not described in this article), has been verified by results in practice, corroborating earlier theoretical expectations. The results rather upset some of the ideas of the intimate dependence of the strength of the mortar on the chemical composition and index of hydraulicity of the binding material, and promise to revolutionize the manufacture of hydraulic lime much as the manufacture even of Portland cement was revolutionized under the influence of the development of fused-alumina cement.

One lime which yielded strengths, in 1:3 standard plastic mortar, of 18 kg. at 7 days and 24 kg. at 28 days, and like all limes cited resisted the boiling tests for soundness, had the following percentages of composition: silica, 14.30; iron and alumina, 8.50; lime, 66.80; magnesia, 0.50; sulphuric anhydride, 0.70, and loss on ignition, 8.90. Some of the other specimens were even more surprising, showing results in the same order with ordinary Portland cements.—P. Feron in *Revue des Materiaux de Construction*, No. 263, pp. 309-10, Aug., 1931.

Herault Bauxite Tracts Disappoint Expectations

One of the French bauxite-producing districts on which fond hopes have been placed is the departément of Herault, where promising outcrops have been worked in three different localities. The Mines Administration at Montpelier in 1928 gave out some figures on the reserves, showing for the three localities a certain reserve of 1,600,000 tons of bauxite with less than 5 per cent. silica and 4,200,000 tons with more than 5 per cent. silica, and "probable reserves" of 8,700,000 and 10,000,000 tons, respectively; it was also stated that a tonnage of around 50,000,000 tons, all grades included, was not impossible for the region of Villeveyrac alone. Later investigations and experiences of commercial operations, however, have caused these figures to shrink considerably, and the future is not bright. Not only have the deposits been found to be less in general than the outcrops indicated, but the quality available is generally much less than had been anticipated. Also, some of the best deposits have been worked down to the hydrostatic level and further mining is impossible or impractical because of the impossibility of keeping the workings free of water. All available data on the Herault deposits adds to the urgency of conserving the other French deposits of bauxite against wanton exploitation and waste.—V. Charrin in *Revue des Materiaux de Construction* No. 263, pp. 322-6, Aug., 1931.

German Gravel Industry Making Rapid Progress

A series of visits to sand-and-gravel operations in Germany has been made by the Association of Sand and Gravel Works of Germany in coöperation with the German Concrete Society, studying the situation of the industry with respect to its capacity for furnishing the scientifically-prepared aggregates needed by modern concrete practice. It has been found that a great number of plants are now in position to furnish materials washed and sized into different sizes and gradings, although unfortunately the concrete industry at present is giving the gravel plants little encouragement. Because of the lower price of sand and gravel from natural deposits the concrete industry has not taken full advantage of the services offered by the gravel producers. An encouraging sign of progress is that in more recent specifications there are increasingly strict demands on the quality of the aggregate. —*Tonindustrie-Zeitung* 55:998, Aug. 31, 1931.

Manufacturers' Publications

Each publication listed below contains information of interest to nonmetallic mineral producers. Readers may obtain, without charge—except where a price may be stated—and without obligation, copies of any of these publications by writing directly to the manufacturers who publish them. Please mention PIT AND QUARRY *when writing.*

Air Separators

Raymond Mechanical Air Separators. 4 p. (Raymond Bros. Impact Pulverizer Co., Chicago, Ill.) Describes and illustrates a new air separator of the "whizzer" type for use in closed-circuit grinding. Applications in the cement, lime, gypsum, phosphate rock, and limestone-screenings fields are noted.

Belting

Veelos Balata Belting. 20 p. (Bull. 31. Manheim Manufacturing & Belting Co., Manheim, Pa.) Describes belting for transmitting power and conveyor and elevator belts and Balata valves for cold-water pumps. Engineering data on pulley diameters to be used for various plies of belting; comparative transmission qualities for belting from 3 ply to 10 ply; pointers on proper belt practice are also given.

Concrete-Products

A Daily Capacity of 2700 Blocks in a City of 12,000 Population. 4 p. (Besser Manufacturing Co., Alpena, Mich.) Describes and illustrates the concrete-products plant of the Alpena Cement Products Co. of Alpena, Mich., tracing its growth and production methods.

Crushers

Type TZ Reduction Crusher. 16 p. (Bull. No. 1110. Traylor Engineering & Manufacturing Co., Allentown, Pa.) Describes and illustrates a gyratory crusher utilizing a new principle in the design of the crushing head and concaves to give greater capacity in producing minimum sizes. Several pages are devoted to the conversion of old-type gyratories by the use of Type TZ head and concaves.

Electrical Equipment

Group-Type Capacitator Equipment. 4 p. (Leaflet 20044F. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.) Describes and illustrates group-type capacitator equipment for power-factor correction on 60-cycle currents. The equipment was developed particularly to meet the need for corrective equipment for loads smaller than synchronous condensers will handle economically.

Motors

Type T Two-Pole Reliance Motors for Direct Current. 4 p. (Bull. No. 210. Reliance Electric & Engineering Co., Cleveland, O.) Describes and illustrates the construction and operating characteristics of a two-pole direct-current motor.

Single Phase Motors. 2 p. (Leaflet 20516. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.) Describes and illustrates the Type CU sealed-sleeve single-phase motor. Features are constant speed, high starting torques, and low starting currents. The motors are offered in sizes from 2 to 7½ hp.

Power Transmission

Vim Short-Center Drives. 148 p. (E. F. Houghton & Co., Philadelphia, Pa.) A complete and entirely new treatise on the short-center belt-drive question that should be of extreme interest to operators. Contains charts, tables and engineering data on 5,000 standard drives ranging from 5 to 100 hp. Permits the working out of transmission problems on an engineering basis.

Westinghouse-Wise Multi-Speed Drive. 4 p. (Leaflet L20520. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.) Describes and illustrates a drive composed of an adjustable speed reducer built into a standard induction motor, allowing instant speed changes while the motor is running under load. Sizes range from ½ to 15 hp. A table of output speeds is included.

Pumps

Amsco Type C Materials-Handling Pumps. 4 p. (The American Manganese Steel Co., Chicago Heights, Ill.) Describes and illustrates a centrifugal pump for handling abrasive and nonabrasive materials in the nonmetallic-mineral industries. Built in 6-in., 8-in., and 10-in. sizes for direct connection or belt drive.

Refractories

Furnace Linings and Arches. 32 p. (Cat. No. 231. McLeod & Henry Co., Troy, N. Y.) Explains boiler settings, linings walls and arches in respect to the employment of refractory brick.

Recording Instruments

Bristol's Thermometer Controllers. 20 p. (Cat. No. 2025. The Bristol Co., Waterbury, Conn.) Describes and illustrates three types of thermometer controllers for temperature ranges of —30 deg. F. to +1,000 deg. F. A line of new recorder controllers is also described and pictured.

Steel

A Classification of Steels for Steel Castings. 12 p. (The Detroit Steel Casting Co., Detroit, Mich.) A technical booklet describing carbon and alloy steels for use in manufacturing castings. Physical property ranges and suitable applications for steels of various analyses are given.

BUILDING-MATERIAL PRICES, OCTOBER 1, 1931

Data collected by the Bureau of the Census and prepared by the Division of Building and Housing, U. S. Bureau of Standards.

City	Portland Cement (*bbl.*)	Gypsum Plaster (*ton*)	Gypsum Plaster Board (*1,000 sq. ft.*)	Hydrated Lime (*ton*)	Building Sand (*cu. yd.*)	Crushed Stone (*ton*)	Roofing Slate (*100 sq. ft.*)
Akron, O.	$1.74	$14.00	$.....	$12.00	$1.50	$2.50	$12.00
Albany, N. Y.	2.34	16.20	23.85	15.75	.....	.....	.....
Atlanta, Ga.	2.00	15.00	.....	12.50	2.81	2.50	.....
Baltimore, Md.	2.10	14.50	25.00	13.00	1.85	2.50	10.00
Buffalo, N. Y.	2.95	16.00	21.00	18.00	2.50	2.05	12.00
Canton, O.	.....	.....	.....	16.00	2.50	.....	.....
Cincinnati, O.	1.94	.....	22.75	14.40	2.63	2.55	.....
Cleveland, O.	1.68	15.00	.....	10.00	1.69	2.15	16.00
Columbia, S. C.	2.25	15.40	35.00	12.50	1.08	2.25	13.00
Columbus, O.	2.35	14.40	.....	12.00	1.50	2.75	14.00
Des Moines, Iowa	1.42	14.00	23.50	19.00	1.40	4.15	15.00
Fairmont, W. Va.	2.80	18.00	35.00	16.00	2.80	3.50	13.00
Grand Forks, N. D.	2.60	19.00	.....	.....	.....	.....	.....
Haverhill, Mass.	2.32	18.50	25.00	18.50	.....	.....	.....
Kansas City, Mo.	1.80	15.00	25.00	.....	1.70	1.88	16.00
Lansing, Mich.	2.25	17.50	.....	20.00	1.80	1.80	.....
Los Angeles, Cal.	2.30	15.20	23.50	24.70	1.85	1.90	.....
Louisville, Ky.	1.86	17.00	.....	15.50	2.00	2.15	15.00
Milwaukee, Wis.	1.75	15.20	22.00	14.00	1.35	1.35	.....
New Bedford, Mass.	2.60	16.50	24.00	16.50	1.75	2.75	.....
New Haven, Conn.	2.70	.....	.....	19.00	1.25	2.25	.....
New London, Conn.	2.60	18.00	25.00	18.00	1.50	3.00	.....
New Orleans, La.	2.20	18.00	.....	13.00	2.00	.....	11.00
Paterson, N. J.	2.00	17.50	24.00	18.00	1.50	2.10	12.00
Philadelphia, Pa.	2.16	17.50	.....	14.50	1.75	2.60	11.22
Poughkeepsie, N. Y.	1.95	.....	.....	.....	.....	2.00	.....
Richmond, Va.	3.10	20.00	31.00	17.50	1.95	2.45	13.00
Rochester, N. Y.	2.28	16.00	22.00	20.00	2.25	2.40	12.00
St. Louis, Mo.	.....	18.00	.....	18.00	1.35	1.30	13.00
St. Paul, Minn.	2.15	17.00	21.00	19.00	1.25	1.75	11.50
Saginaw, Mich.	1.76	17.00	24.00	16.00	2.25	.....	14.50
San Antonio, Tex.	2.43	17.00	42.00	20.00	2.25	2.35	16.50
San Francisco, Cal.	.....	16.90	45.00	22.50	1.40	1.60	15.00
Scranton, Pa.	2.40	19.00	.....	20.00	3.25	.....	.....
Seattle, Wash.	2.40	18.00	35.00	22.00	1.40	1.90	.....
Shreveport, La.	3.00	20.00	.....	.....	2.00	3.20	18.50
Sioux Falls, Ia.	2.40	15.50	.....	24.00	1.25	2.25	.....
Syracuse, N. Y.	2.16	15.00	25.00	13.00	1.80	1.70	13.50
Tampa, Fla.	2.60	.....	.....	24.00	2.00	4.00	.....
Terre Haute, Ind.	2.25	18.00	28.00	18.00	1.25	3.00	13.25
Toledo, O.	1.80	14.00	21.00	15.00	1.60	1.75	.....
Trenton, N. J.	2.20	17.00	22.50	18.00	1.50	2.15	10.00
Tucson, Ariz.	2.25	17.10	45.00	30.00	1.25	2.25	.....
Tulsa, Okla.	1.90	16.00	22.50	22.00	.85	2.35	.....
Washington, D. C.	1.78	16.00	25.00	12.00	.....	.....	.....
Waterbury, Conn.	2.60	20.00	30.00	20.00	1.25	2.45	15.00

New Machinery and Supplies

Three-Point Suspension On New Crawler Tractor

The Hercules crawl tractor, the newest development in crawler tractors just announced by The Hercules Co., Marion, O., was developed to meet the requirements of heavy-duty tractor users. The crawl tractor is capable of safely working on ground so broken and rough that the ordinary tractor would pitch or roll over sideways. Each rear crawler unit is free to rotate on its axle and combined with the gyroscopic-mounted front wheel, gives the machine a three-point suspension which compensates for the most uneven ground encountered on any type of job and brings stability and tractive force hitherto unknown under rough conditions. Because of this three-point suspension it crosses ditches or passes over steep hills easily without pitching and removes all danger of overturning or "nose diving." Users who have seen its remarkable performance have been quick to pronounce it "the safe tractor."

The Hercules crawl tractor is a standard Model 60, 80 or 100 Hercules chassis mounted on two rugged crawler trucks. The Hercules chassis brought a new order to machinery design with the use of anti-friction bearings, and in keeping with this progressive standard the crawler trucks are mounted on ball and roller bearings. All that is necessary to convert the crawl tractor into a roller is to jack up the rear end, take off the crawler trucks, and replace the roller wheels.

The Model 60 crawl tractor develops a draw bar pull of 8,000 to 10,000 lb. which may be increased for special work. The draw-bar pull of the Model 80 and 100 is greater in proportion.

All models have three speeds forward and backward — direction and motion being controlled by the movement of a single operating lever. The standard Hercules tractor has a speed of ½ m.p.h. in low, 1½ m.p.h. in second, and 2½ m.p.h. in high, and these speeds can be increased or decreased to meet special operating conditions.

All models of Hercules crawl tractors are powered by a standard nationally-known six-cylinder engine with an ample power reserve easily to handle the most unusual conditions likely to be met.

The shovel in operation showing operator cozily inclosed in cab.

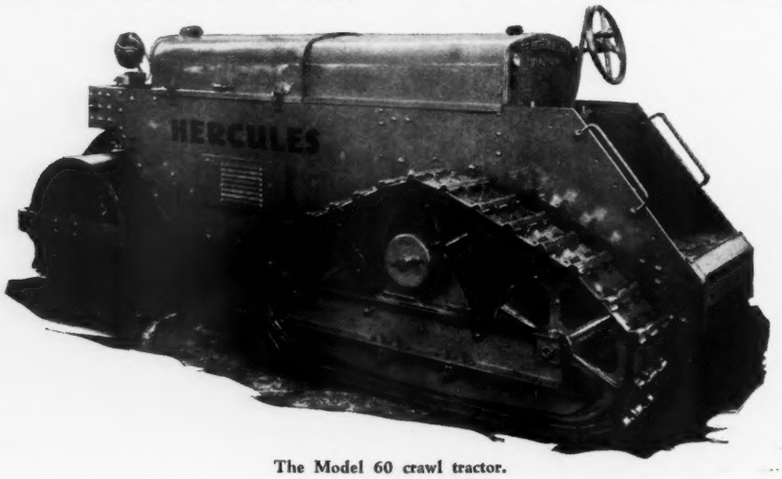
Inclosed Operator's Cab Made Feature of Shovel

The Michigan Power Shovel Co., Benton Harbor, Mich., has announced an inclosed model of its shovel which provides complete protection for the operator.

One of the features is clear vision for the operator at all times. The cab is designed so that sides and front can be removed if desired and the interior is of sufficient size to permit complete servicing of the turn-table mechanism.

The Michigan shovel is said to be the first shovel ever manufactured having the features of full-circle loading with no tail swing and enclosure for the operator.

A complete dealers' organization extending from coast to coast now handles the sales and servicing of Michigan power shovels, cranes, draglines, etc.



The Model 60 crawl tractor.

Counter-Balance Gives Smooth, Positive Action

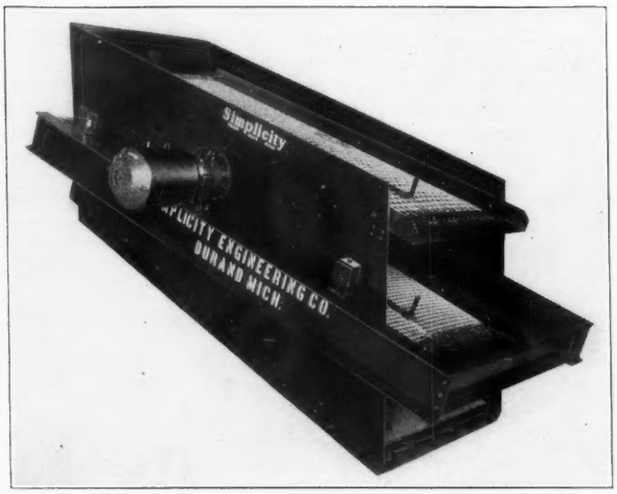
The new Simplicity utility gyrating screen announced by the Simplicity Engineering Co. of Durand, Mich., is said to be the original type of mechanically-vibrated screen using a counterbalanced eccentric shaft. This counter balance is machined directly on the shaft, thus giving positive action with perfect smoothness. A simple balance compensator mounted on the end of the shaft allows the field operator easily to adjust for any changes in screen-cloth weight so as to maintain perfect balance and smoothness.

Resilient rubber mountings support the screen corners so that all the positive gyrating action is imparted to the screen decks and not lost by being dissipated throughout the supporting framework. This eliminates excessive structural wear and increases the screening efficiency.

The screen cloth is stretched taut all four ways over bars which are crowned both sideways and endways. This does away with cloth sag and so

eliminates wire whip with its eventual destruction of the cloth.

The complete gyrating assembly is carried by heavy-duty ball or roller bearings in dust- and water-proof housings protected by special bronze seals. Four Alemite fittings lubricate the entire moving assembly. This entire assembly can be completely removed in a short time for repairs or interchanged end for end to change the hand of drive.

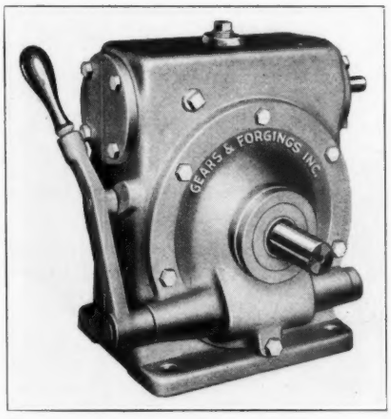


The gyrating screen with built-in motor.

The screen can be furnished in various sizes and in single-, double- and triple-deck types; flat pulley, V-belt drive and direct-motor drives, too, can be supplied. The motor-driven unit has the motor mounted directly on the end of the shaft, an exclusive feature. This does away with belts, gears, pulleys and couplings, providing a very safe and quiet running unit.

New Speed-Reducer Has Two Speeds, Worm Gears

A two-speed, worm-gear reduction unit, designed for either horizontal or vertical drives of ⅛ hp. and up where two speeds are required, has recently been introduced by Gears and Forgings, Inc., Cleveland, O. This type of speed-reducer is manufactured in-



Two-speed worm-gear reducer.

tegral with the motor or as a separate reduction unit, in speed-reduction ratios ranging from 4:1 to 150:1.

The unit consists of a worm and worm gear and a set of differential gears, the driving shafts and their Timken roller bearings all enclosed in a sturdy leakproof and dustproof cast housing. The two speeds are obtained by means of the differential gearing. The high speed is obtained by moving the small hand lever to the right. This locks the differential to the low-speed shaft on which the worm gear and differential gearing rotate as one unit. Movement of the hand lever to the left locks the side gear of the differential preventing its rotation. Thus one-half of the revolutions of the worm gear are imparted to the slow-speed shaft. Change of output speed can be made while the unit is in operation under full load.

The worm gear of this speed-reducer is chilled nickel bronze; its shaft is S. A. E. 3145 steel. For the worm, which is forged integral with its shaft and hardened and ground, S. A. E. 2315 steel is used. All the gears in the differential are of heat treated alloy steel. Running in a bath of oil, the gears receive perfect lubrication. A plug is provided in the housing for determining if proper oil level is maintained.

Electric Space Heater for Isolated Locations

Two feet long, slim and sturdy is the description given for a new space heater, announced by Cutler-Hammer, Inc., Milwaukee, Wis. The heater is of an entirely new design. Its heating element is nickel-chromium alloy. A highly refractory granular compound is used for insulation. No cement or spacers are used. A new process of imbedding the element in this compound under immense pressure makes the new space heater immune to vibration and jarring, it is claimed.

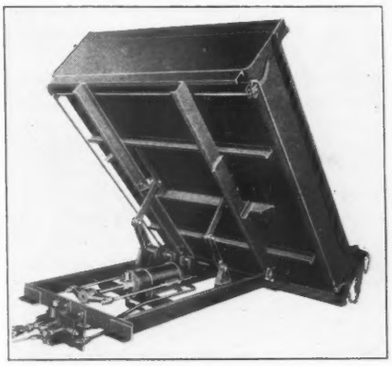
The new heaters have a normal rated capacity of 500 watts. They are furnished for 100-125 volts and 200-250 volts, either direct or alternating current. They are not subject to damage from even unusual voltage peaks because of their exceptionally high overload capacity which is gained by the new method of construction.

A few of the many uses of these space heaters are in crane and shovel cabs, watchman's houses, small isolated offices, in fact, any place where it is uneconomical to extend the central heating system.

A descriptive pamphlet on this new space heater will be sent upon request, by the manufacturer.

Heavy-Duty Hydraulic Hoist Unit Announced

The Perfection Steel Body Co., Galion, O., announces the production of a new heavy-duty hydraulic hoist for all 1½-ton, short-wheelbase chasses, with a complete line of steel bodies. This hoist is a distinctly rugged, heavy-duty job, designed and built for over-capacity service. Besides its sturdy construction, the outstanding feature is the "cushion-drop" mechanism or



Hoist mechanism beneath body.

automatic control which gives it the advantage of dropping the body, either full or empty, rapidly to the riding position without "slamming" the frame. The hydraulic cushion becomes effective when the body frame comes to within several inches of the chassis, then it eases down to the full-riding position.

The hoist raises the load to a 50-deg. angle in less than four seconds and returns it by controlled gravity to any intermediate position. Its safety feature is a distinct advantage. Auto-

The bar-type space heater.

Truck body hoisted for dumping.

matic valve mechanism holds the body in any raised position in case the power fails, the engine stops, or even if the power clutch is released accidentally. The loaded body will also "ride" in any raised position on this hydraulic cushion. The manufacturer claims a distinct saving of time in unloading operations and a saving in the cost of operation through lessened "wear and tear" on the mechanism.

Ford-Powered Locomotive Has Unusual Guarantee

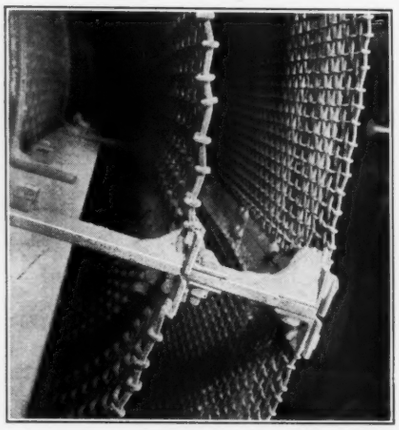
The Brookville Locomotive Co. of Brookville, Pa., announces a new and improved locomotive using a Ford Model AA power plant. The chassis, running gear and all other parts are guaranteed against breakage or failure due to inferior parts, faulty workmanship or ordinary wear for a period of six months; with the exception of injury by accident or misuse. The power plant and all other parts manufactured by the Ford Motor Co. are known to be reliable and can always be inexpensively serviced by Ford dealers.

Dual-spring-journal wheel suspension permits use over rough, crooked tracks. Steel tires provide 25-per cent. greater traction. A four-speed reverse, providing four speeds in either direction, up to 16 miles per hour, employs high-grade spiral bevel gears, Timken bearings are used and operate under an oil bath in a dust-proof housing.

The locomotives are offered in 2, 2½, 3, 3½ and 4-tons weight for any gauge of track.

Screen Still in Service After 5 Years' Operation

The Ludlow-Saylor Wire Co. of St. Louis is redistributing a booklet printed in 1927, containing an illustration of its first installation of "spring-steel" woven-wire screens, which were placed in service in July of 1926.



A view of the original screen.

This illustration, reproduced herewith, shows a portion of two concentric revolving-screen jackets made of "spring-steel" wire, which to date have given more than five years of service on a 24-ft. cylindrical scalping screen. The feed is Illinois limestone, and at peak load the crusher delivers 400 tons per hour to the scalping unit.

Spring-steel is said to be ideal for woven revolving-screen jackets. On vibrating screens, also, it is said that many crushing plants are getting twice the life as compared with ordinary screen sections, while others are getting several times the service they formerly expected from their screens.

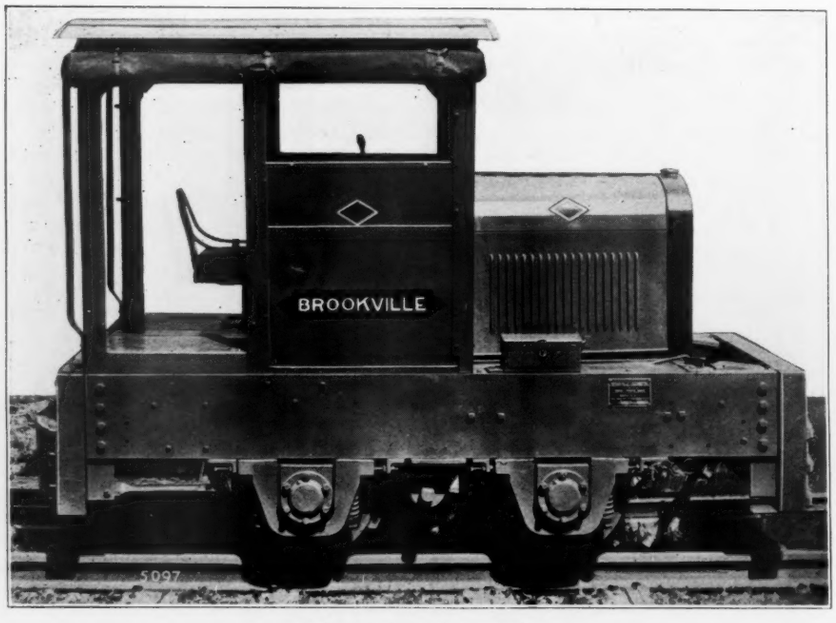
The screens are now available in all grades used on revolving and vibrating-screen equipment, from coarse grades woven of ¾-in. bars down to 12-mesh screens of No. 20 wire.

Paper-Bag Firm Erects Factory at Los Angeles

The Jaite Co., manufacturer of multi-wall paper bags, has purchased a harbor site at Los Angeles and will start the erection of a new plant as soon as plans are completed. The company was established about 30 years ago at Jaite, O., and has grown to be an important factor in the paper-bag business, having a plant and paper mill near Cleveland, one at St. Helens, Ore., offices at San Francisco and the new plant under erection at Los Angeles.

Harry O. Strom is Pacific Coast manager and is located at the northern plant. Forrest Barrett is stationed at 2000 Evans avenue, San Francisco, and Gus A. Bauman at the new plant, 830 East D street, Los Angeles—temporary location at 245 N. Fries avenue, Wilmington, Calif.

The first unit of the new plant is of reinforced concrete construction, covering an area of 20,000 sq. ft. The latest and most improved machinery will be installed, having a capacity of 40,000 bags daily, with provision for expansion.



Ford-engine-powered locomotive.

Resents Quarries Being Called Swimming Holes

To the Editor:

In the Oct. 21 issue of PIT AND QUARRY an article by James H. Lees, assistant state geologist of Iowa, refers to Jones County quarries as "most excellent swimming holes."

We have operated a quarry in Jones County for more than 50 years and we are still open for business. We have some stiff opposition, however, from a quarry owned by the state of Iowa and operated by the Iowa State Reformatory with convict labor. The output of this quarry is sold to the Standard Supply Co. of Des Moines at prices much lower than can be met by privately-owned quarries operated by free labor. However, we are still in the game and we object to having our quarry advertised as a "most excellent swimming hole!" We have written Mr. Lees to this effect.

H. DEARBORN SONS

Stone City, Ia. *H. F. Dearborn.*

Operators Find Log-Washers Real Aid in Producing Clean Aggregates

LOG-washers are finding extensive use in crushed-stone and sand-and-gravel plants and many operators report a highly improved product, according to a survey of plants using this equipment made recently by the McLanahan & Stone Corp., Hollidaysburg, Pa. Some of the plants studied, together with views of the log-washing equipment, are described here.

One of the accompanying pictures shows the log-washers on the top of the limestone storage bin at the plant of the Bethlehem Mines Corp., Naginey, Pa., a subsidiary of the Bethlehem Steel Corp. These logs were installed at the company's Steelton plant in 1914 and removed to the Naginey plant about 1928, where they are still in service. The new Steelton plant is also equipped with McLanahan washing equipment but the washing problem differs somewhat from the tough clay found at Naginey. The smaller sizes of stone and dirt are conveyed to the washer, which is followed by screens which size material into the different bins.

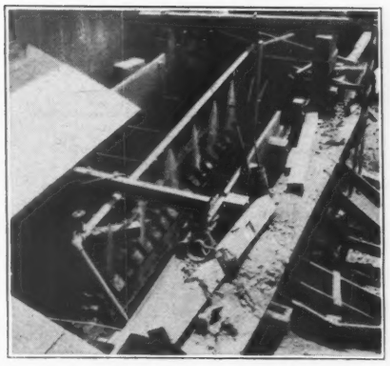
At the plant of Semet-Solvay Co., Moline, Kan., another view shows the log-washers receiving 3½-in. material from a roll-grizzly ahead of the primary crusher. The waste product is clay and shale. Until the washer was installed it was practically impossible to use the stone for road purposes, on account of the soft rock. Now they have even discontinued stripping and the top 3 ft. of refuse is quarried along with the stone, and the logs reject the soft and undesirable material.

The Interstate Sand & Gravel Co. plant at Covington, Ind., has a minimum capacity of 1,000 tons in ten hours. The fine sand carries little refuse, consequently the minus ¼-in. material is screened out first and washed in screens, scrubbers and washing screws. One pair of logs handles the minus-2-in. square to plus-1¼-in. round; the other pair the minus-1¼-in. to plus-¼-in. by ¾-in. slot. Both machines are operated at 25 r.p.m. from one line-shaft by a 100-hp. motor, and can easily be started under load. This gravel pit contains clay and soft rock which, after being washed in steel logs, tested 99.1 per cent. satisfactory.

At the plant of the Cast Stone Construction Co., Mapleton, Ill., all material is loaded by a high-boom dragline into the main plant hopper and from there by 24-in. conveyor to a double-shell washing screen. Material through the ¼-in. holes goes by gravity to a double dewatering sand drag,

Pair of log-washers at the plant of the Cast Stone Construction Co.

each side of which is 4 ft. wide by 12 ft. long. This delivers to an 18-in. belt which elevates the sand to a stock-pile under which is located a long conveyor. This carries the sand to boats or barges in the Illinois River adjoining the plant. The oversize from the main screen drops by gravity to an 18-in. belt which carries it to a crusher, from there it drops to the 24-in. main conveyor, forming a closed circuit. The plus-¼-in. to minus-2-in. from the main screen located over the top of the log-washers feeds by gravity to a 25-ft. log-washer. This delivers



The log-washers in operation at the Semet Solvay Corp. plant.

to the 18-in. conveyor. The product is elevated to a screen where it is separated into three sizes, and each size is delivered to a separate stock-pile located over the same pit conveyor as above, so that any size or mixed sizes can be loaded at any time to the boats.

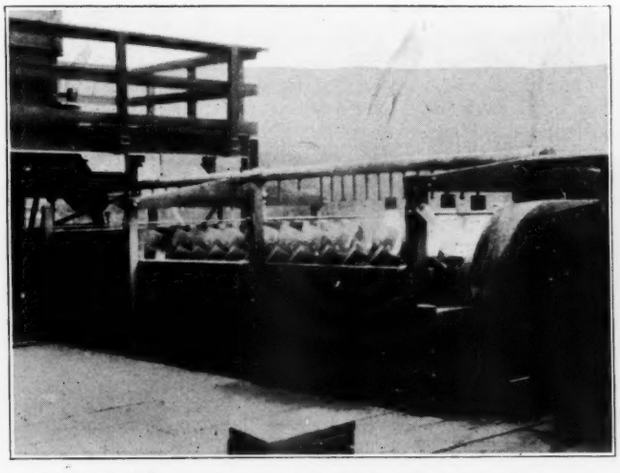
Museum Exhibit Devoted to Varied Uses of Silica

Three large exhibition cases in the department of geology at Field Museum of Natural History, Chicago, are devoted to illustrating the uses of silica.

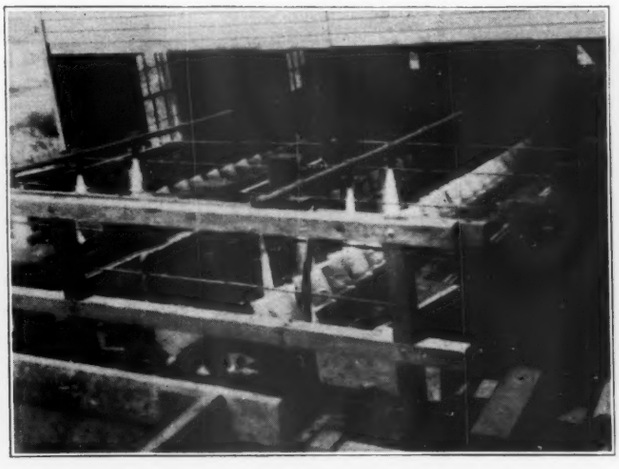
The collection includes ornamental and gem varieties, such well-known substances as plastering and building sands and such comparatively little known objects as a flask for chemical use blown from molten quartz and a specimen of smoky quartz which the Chinese use to make dark spectacles.

Louisville Supply Firm Chosen Representative

The Neille LaVielle Supply Co., 505 W. Main St., Louisville, has been appointed local representatives for Foote Bros. line of gears and speed reducers.



Steel log-washers removing clay at the plant of Bethlehem Mines Corp.



Spray nozzles and logs at the Interstate Sand & Gravel Co. plant.

Legal Information for Operators

Employer Not Liable if Fellow Worker Is Hurt

Generally speaking, a workman presumably assumes all the risks ordinarily incident to employment. Therefore, where one employee is injured by another the question is whether the two servants were fellow servants. If they were, then the injury is within the risk ordinarily incident to the service undertaken and the employer is not liable in damages.

For illustration, in Walsh *v.* Eubanks, 34 S. W. (2d) 762, it was shown that a truck driver was transporting other employees for the purpose of having them assist him in unloading a car of cement. During the trip the truck driver collided with another automobile, seriously injuring one of the workmen who was riding with him. The workman sued the employer for damages. It is important to know that the court held the employer not liable, and said:

"The principle involved here which exempts the master from liability for an injury to a servant occasioned by the negligence of a fellow servant has long been settled. . . . . A fellow servant is any one who serves and is controlled by the same master. Common employment is service of such kind that, in the exercise of ordinary sagacity, all who engage in it may be able to foresee, when accepting it, that through the carelessness of fellow servants it may probably expose them to injury."

Gypsum Maker Entitled to Sue on Surety Bond

Generally speaking, if a contractor's bond contains a provision obligating the contractor to pay for material, it is for the benefit of the material men, upon which they are entitled to maintain a suit directly against the surety.

On the other hand, when the bond is intended solely to secure performance of the contract and contains no clause from which an express obligation for the benefit of material men may be derived, a suit by a stranger to the contract may not be maintained. The latest higher-court case involving this important point of the law is Aetna Casualty & Surety Co. *v.* United States Gypsum Co., 39 S. W. (2d) 234.

The facts of this case are that a contractor and an owner entered into an agreement by the terms of which the former agreed to construct a building. The contractor furnished a bond containing the following clause:

"If the principal shall faithfully perform the contract on his part and fully indemnify and save harmless the owner from all cost and damage which he may suffer by reason of failure so to do and shall fully reimburse and repay the owner for all outlay and expense which the owner may incur in making good any such default and shall pay all persons who have contracts directly with the principal for labor or materials, then this obligation shall be null and void. Otherwise, it shall remain in full force and effect."

The contractor defaulted and the gypsum company and subcontractor filed suit against the surety company. The question presented the court was the interpretation of the contract to ascertain whether it contained any provision for the benefit of the material man.

It is interesting to observe that the higher court held the material man entitled to file suit and that the surety was liable on the bond. This court stated the following important law:

"Was the bond so far and so directly for the benefit of the subcontractor that it can maintain against the surety company this action thereon? . . . If the contract is sufficient in its terms to manifest an intention that the contractor shall pay for the labor and material, it is a valid obligation and enforceable in favor of any person for whose benefit it may have been executed. . . . It was never the idea that the surety should have the option of paying the penalty of the bond and put upon the property owner the task of satisfying the various claimants and lienholders and perhaps of having to complete the job itself. The parties to the contract surely contemplated that the surety should be put to all this trouble, and that the penalty of the bond was only security for its performance of the conditions of the bond."

Court Holds Raw Mix Is Not True Cement Mortar

In order to constitute an express warranty no particular language is necessary. It is not required that it shall be in writing, or be made in specific terms; and it is not at all necessary that the word "warrant" or "warranty" shall be used. Any direct and positive affirmation of a matter of fact, as distinguished from a mere matter of opinion or judgment, made by the seller during the sale negotiations and as a part of the contract, intended by him to induce the purchaser to make the contract, and actually relied upon by the latter in making the purchase, will be deemed to be a "warranty."

For instance, in Trudgeon *v.* Patterson, 299 Pac. 419, a contractor ordered 450 sacks of "bricklayers' cement." The seller delivered material represented to be bricklayers' cement but which was "raw mix." The contractor used the material until the walls of the building were about twenty feet high, when it rained and the mortar washed out. The contractor was compelled to tear down the brick wall, take out the "raw mix" mortar and reconstruct the wall. He sued the material man for damages in the sum of $2,008.

In holding the material man liable, the court said:

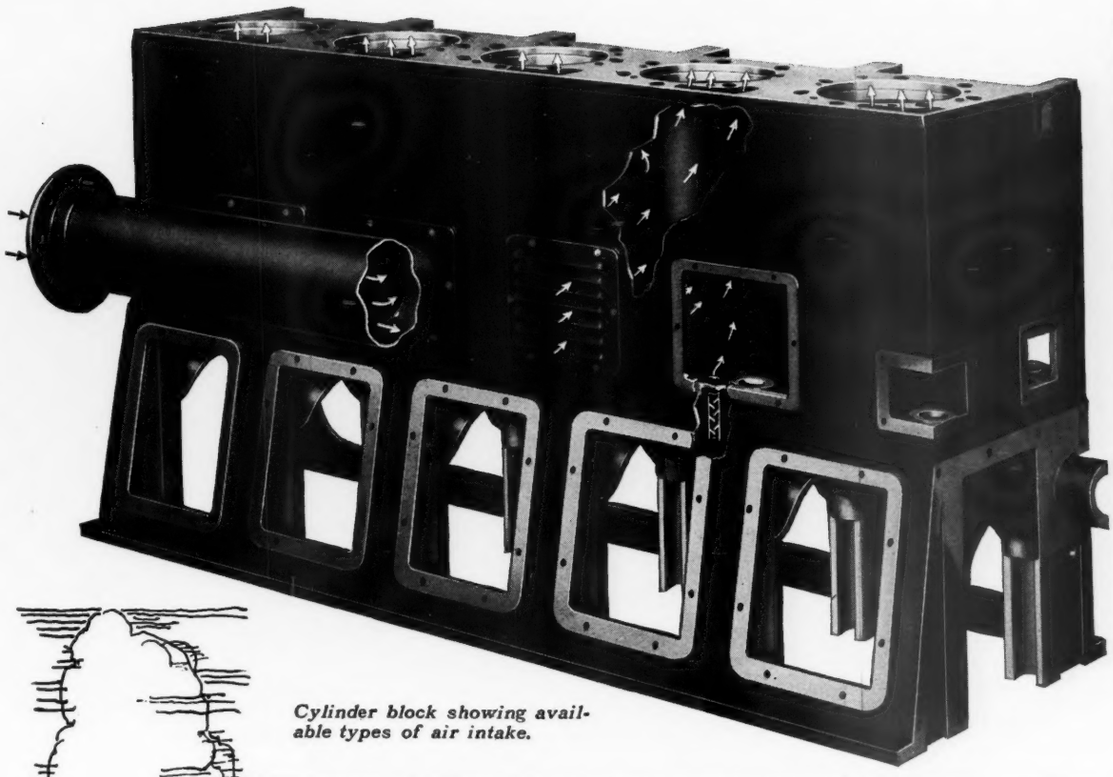
"In the case at bar plaintiff (contractor) sought to purchase from the defendant a well-known material, known as 'bricklayers' cement.' Defendant agreed to sell and furnish to plaintiff said material. This was an express agreement, and it is an implied warranty that goods so furnished were suitable to perform the ordinary work for which they were intended. . . . In the instant case an examination by an experienced bricklayer did not disclose the defect. . . . Plaintiff (contractor) wanted to buy, of the defendant, bricklayers' cement, and the defendant agreed to sell bricklayers' cement."

Surety Is Relieved in Contractor's Bond Case

It is well-established law that a surety may be relieved from liability on a contractor's bond if the owner performs any act in violation to the terms of the bond, or if he makes advances to the contractor for a greater amount than is due the contractor by the terms of the construction contract.

For instance, in Detroit Fidelity & Surety Co. *v.* Bushong, 175 N. E. 683, it was disclosed that a contractor furnished a bond which provided that the surety would not be liable if the owner failed to make payments in accordance with the building contract. Upon request the owner paid to the contractor an amount of money which was greatly in excess of that which actually was due. Later the contractor abandoned the construction job and the owner filed suit against the surety. In holding the surety not liable, the Court said:

"The surety may not stand upon the strict letter of its undertaking and demand to be released therefrom for any and every variation in the terms or the performance of its principal's contract, with reference to which the surety's agreement is made, but it may insist upon the compliance with material requirements, clearly expressed, which are made the condition to liability. A surety on a bond to secure the faithful performance of a building contract, which provides that payment shall be made at specific times as the work progresses, is released from liability under a bond if the owner, without the surety's consent, makes advances to the principal in excess of the amount due by the terms of the contract."



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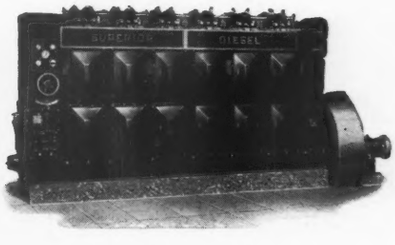
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